GENERATION, TRANSMISSION AND APPLICATION OF THE POWER SERVICES

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# Power

JANUARY
1955 • 50¢

A McGRAW-HILL PUBLICATION

Power MODERNIZATION PROGRAM

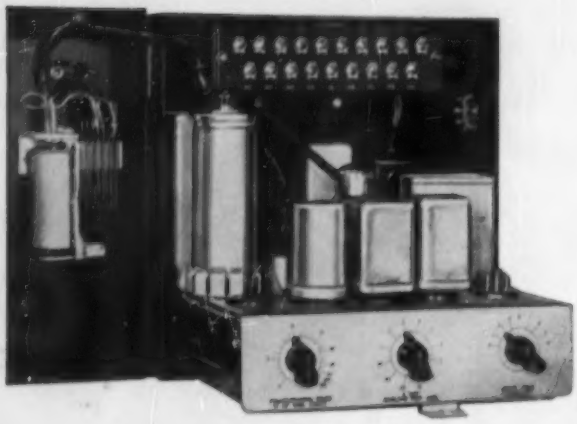
How to win recognition for your plant • 80

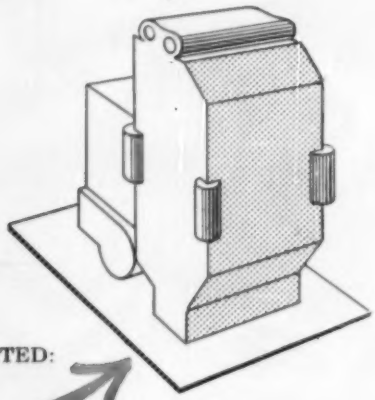
CONTROL ACTIONS:

- *Proportional Action*
- *Reset Action*
- *Rate Action*
- *Anticipatory Action from changes in combustion rate*

CONTROLLING QUANTITY OR FUNCTIONS:

- *Superheat Temperature*
- *Reheat Temperature*
- *Sum or Difference of Superheat and Reheat Temperature*





EQUIPMENT ACTUATED:

- *Desuperheating valves*
- *By-pass dampers*
- *Tilting burners*
- *Gas recirculation dampers*
- *Proportioning dampers*
- *Condenser valves*

## THIS ELECTRONIC CONTROLLER HAS THE

# flexibility

## TO HANDLE YOUR SUPERHEAT-REHEAT CONTROL PROBLEMS

**Here is a controller** which looks at superheat temperature, reheat temperature or any of their combinations—electronically "computes" the proper control action—and applies it to the correct actuator or group of actuators.

This flexibility of control is vitally important in regulating today's critical superheat-reheat temperatures. Your boiler may employ dampers, tilting burners or valves, separately or in combinations, each having its individual control characteristics. In many steam generators a single actuator affects both superheat and reheat temperatures over part of the load range. As load and furnace conditions require the control to regulate different actuators or groups of actuators, the *control actions* as well as the *controlling quantity or function*—superheat, reheat, or the sum or difference of these temperatures—must be varied accordingly.

The built-in electronic intelligence of the L&N Series '50 Controller enables it to consider all these variables simultaneously. This controller has been supplied with as many as four separate groups of *control actions*—proportional, reset, rate and anticipatory—to meet individual control needs.

Inherent self-balancing permits rapid automatic transfer from one actuator to another, while introducing a completely new set of control actions, as well as a different control quantity or function.

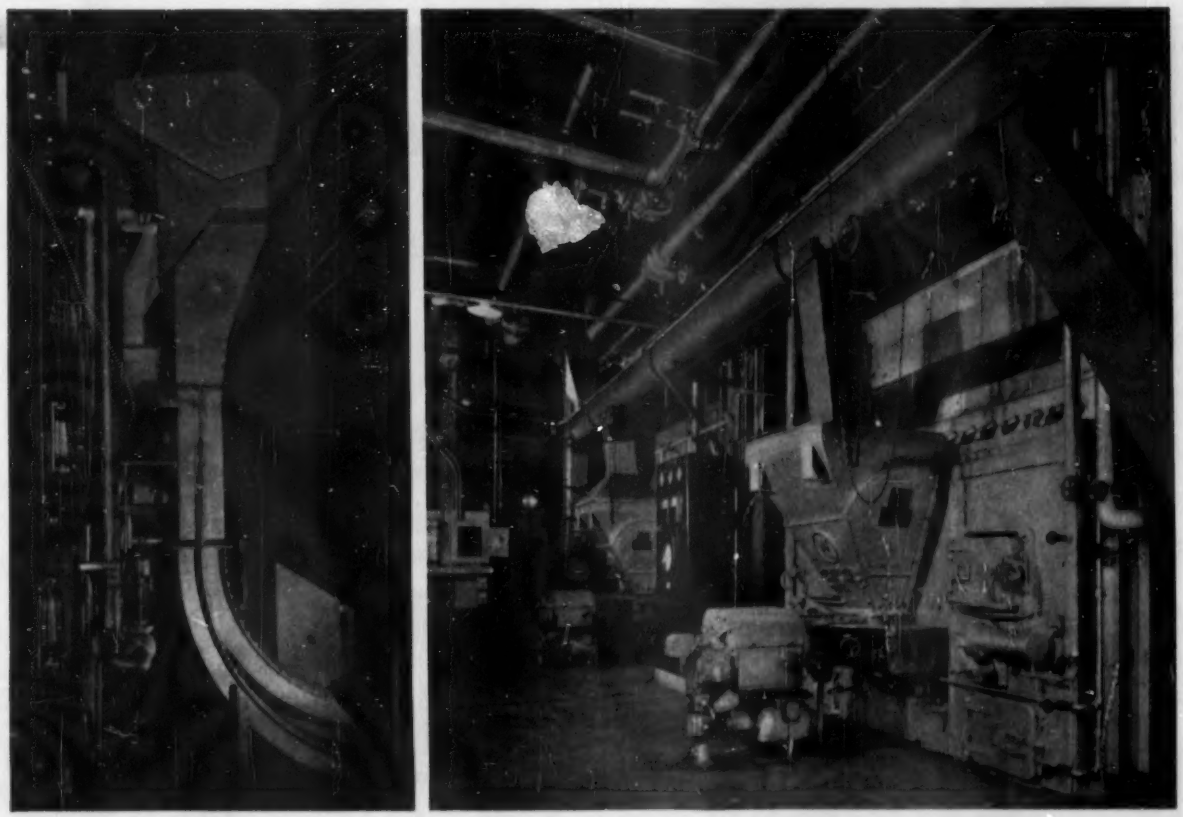
Inherent flexibility of the Series '50 Controller allows the complete superheat-reheat control system to guard against interaction of the two steam temperature controls and to provide the close temperature regulation your boiler requires.

If you're thinking of tomorrow's—as well as today's—superheat-reheat control problems, why not look to L&N—the only instrument company offering integrated controls for *both* steam and electrical generation. Write Leeds & Northrup Co., 4910 Stenton Avenue, Philadelphia 44, Pa.

LEEDS [N] NORTHRUP

*instruments* — *automatic controls • furnaces*

# Hospital gets dust-free coal handling . . . AT LOWER COST!



Left: Link-Belt Bulk-Flo conveyor-elevator moves coal from storage bunker to screw conveyor, serving stoker hoppers of two steam boilers (right). Coal discharge is regulated by sidegate at hopper bottom. Power is transmitted by individual Link-Belt gearmotors and roller chain drives. Conveyors are enclosed to retain dust.

## Steam plant is modernized with LINK-BELT Bulk-Flo and Screw Conveyor System

DEMANDING high standards of cleanliness, Butler (Pa.) County Memorial Hospital installed a compact, enclosed Link-Belt coal conveyor system. Replacing manual shoveling, the present arrangement requires only that the attendant open discharge gates by means of a hand wheel . . . then press a button to set conveyors in motion.

Whether your plant is large or small . . . inside or outside storage . . . supplied by boat, rail or truck—Link-Belt has successfully built many similar installations. Applying that vast and varied background to your problems results in top efficiency . . . lower cost per ton of coal handled. And remember: Link-Belt engineers think in terms of a complete line of equipment. Recognizing your needs, they can select the right elements to fulfill them most simply, effectively and economically.

*Send today for a copy of Book 2410 . . . 44 pages of drawings and photographs of many outstanding coal handling systems of all types —large and small.*

**LINK-BELT**

**COAL HANDLING EQUIPMENT**

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. LB.8311

**DE LAVAL**
**OPPELLER PUMPS**

# *are used for boiler feed on floating process plant*

**Three De Laval Oppeller Boiler Feed Pumps** play an important role in the Freeport Sulphur Company's new process which mines sulphur from a deposit beneath the Gulf of Mexico. This floating plant is located in the marshes in Bay Ste. Elaine, Louisiana.

The De Laval Boiler Feed Pumps operate at 3,500 rpm with water heated to 297F. They are built with 12% chrome steel impellers and trim. The dependable performance of these units has led Freeport Sulphur to purchase six additional pumps for boiler feed service at two other mines. In addition to boiler feed, De Laval Oppeller Pumps are used throughout industry for mine dewatering, descaling, desuperheater feed as well as for services in the petroleum, pipeline and marine fields. Capacities range up to 2,000 gpm, pressures to 1,200 psig, temperatures to 350F; materials to suit any service. For complete data, send for Catalog 1502.

**DE LAVAL** *Oppeller Pumps*

DE LAVAL STEAM TURBINE COMPANY

*815 Nottingham Way, Trenton 2, New Jersey*

# Power

JANUARY 1955 • VOLUME 99 NUMBER 1

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**Print order this issue: 47,347**


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**MODERNIZATION,** the keynote of POWER's Mid-September issue, gets the cover spot this month, focusing attention on this year's program, announced on p 80.

The cover shows Howard Kallen, Assistant Editor, presenting a citation to Charles Hiss, representing the engineering division of Goodyear Tire & Rubber Co, for the firm's outstanding accomplishment in modernizing its power-service facilities. H A Flannery, manager of Goodyear's engineering division, is an interested onlooker. Presentation of the award was made at Plant 2 power plant, Akron, O.

Savings of about $3000 per day are expected at this plant alone, good reason for power-service men to take another look at their plants to see where and how modernization will cut costs all along the line.

### *Next month . . .*

■ Another installment in the Nuclear-Energy Study Course, in which you'll get a closer look at the neutron and its reactions with atomic nuclei.

■ Low-cost air for industrial blowing operations can be a tricky problem unless you know the ins and outs. Frank Bond, U.S. Hoffman Machinery Corp, shows how to figure actual costs in these systems. His method is a good tool for both plant designers and operators. See it in February.

■ Basic data on scale formation in boilers is the subject of an article by L W Fitzpatrick. Corrective measures practical for all plants are also given.

■ Don Swift, in installment 12 of his power-plant organization series, gives many good pointers on chimneys, breechings, fan controls and dust collectors. Read his valuable tips in February.

### *. . . and future months*

■ A picture story on the use of welding fittings and flanges in modern piping systems will show the versatility of these units and point out many ready-to-use design and installation hints. The unusual presentation of this story is certain to catch your eye, while making it easier for you to get ideas from it for all types of piping in your plant.

# MORE POWER...LESS FUEL ...OVER LONGER PERIODS

**YOUR BEST** assurance of low fuel consumption—and low maintenance costs, too—is to use effective lubrication: one of the famous *Texaco Ursa Oil* series, a complete line of diesel lubricating oils especially refined to make engines deliver *more power* with *less fuel* over *longer periods* between overhauls.

Use the recommended *Texaco Ursa Oil* and enjoy clean operation...freedom from harmful deposits...rings always free for proper compression and combustion...longer life for parts. These are the benefits that explain why—

**For over 20 years, more stationary diesel h.p. in the U.S. has been lubricated with Texaco than with any other brand.**

Let a Texaco Lubrication Engineer give you the full story on how *Texaco Ursa Oils* can help you reduce your diesel operating costs. Just call the nearest of the more than 2,000 Texaco Distributing Plants in the 48 States, or write:

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TEXACO

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**FOR ALL DIESEL, GAS AND DUAL-FUEL ENGINES**

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## ...with Power readers...

ALUMINUM PIPE . . .

I always read with interest your column "Practical Ideas." You have done an excellent job in the presentation of ideas to help all.

For example, in the July issue, the article . . . on steam-jacketed aluminum piping is most interesting. We are planning to try this out on our liquid sulfur lines in the near future. I . . . have a sample of this pipe and it looks excellent. As you perhaps know, all liquid sulfur lines carry an internal steam line to prevent "freezing." I believe this new piping has great possibilities for use in this service.

*Minatitlan, Ver., Mex.* W P BARNARD

NUCLEAR ENERGY

I have been reading every part of the "Nuclear Energy Study Course" and thoroughly enjoy them because, for once, I can easily understand the basic facts of nuclear action without racking my brain. The writing is clear and to the point.

The technical press needs more articles like this that go to the heart of a subject without fancy words and formulas.

*Chicago, Ill.* JAMES BLANCHARD

## ...lines and bylines

W J Fadden

**CHIEF MECHANICAL ENGINEER** with The Kuljian Corp., William J Fadden, Jr, joined that organization in 1941 and since then has played an active role in the design, specification and layout of central-station and municipal power plants. Before joining Kuljian, Fadden served as mechanical designer in the switchgear department of the General Electric Company.

A graduate of Drexel Institute of Technology and a registered professional engineer, he worked in sound ranging (locating enemy artillery by sound) in World War II. Since the war he has undertaken such assignments as project engineer for the 15,000-kw semi-outdoor power plant at Chamois, Mo., the new smelting plant of George Sall Metals Co, an underground boiler plant and accumulators for the U.S. Navy steam catapult, waste-heat boilers, and a major rehabilitation program at Power House No. 1 of The Ford Motor Co.

Fadden won wide recognition as the designer of the "Kulculator," a copyrighted circular slide rule for calculating pressure drop and velocity in steam pipes. Right now he's riding high after his recent appointment as chief mechanical engineer of The Kuljian Corp.

A K Sukumar

**MECHANICAL ENGINEER** in the Power House power and utilities section of The Ford Motor Co's manufacturing services division, Anbalavattath K Sukumar joined Ford in 1927 after graduation from University of Michigan.

Starting as a fireman, he successively held positions as boiler tester, instrument and test engineer, and utilities engineer in Ford power plants.

Sukumar was born in Malabar, India, and educated at the Madras Christian College High School and Victoria College in India before coming to the U.S. in 1923. Entering University of Michigan in 1924, he graduated three years later with a bachelor's degree in mechanical engineering. He is a registered professional engineer in the state of Michigan.

S J Haas

**MAINTENANCE** and lubrication engineer with The Electric Storage Battery Co, Plant Engineering Dept, Samuel J Haas is author of the hard-hitting lube story beginning on p 120. Sam, 34 years old and married, studied mechanical engineering at Drexel Institute and production management at Penn State University, Ogontz Center.

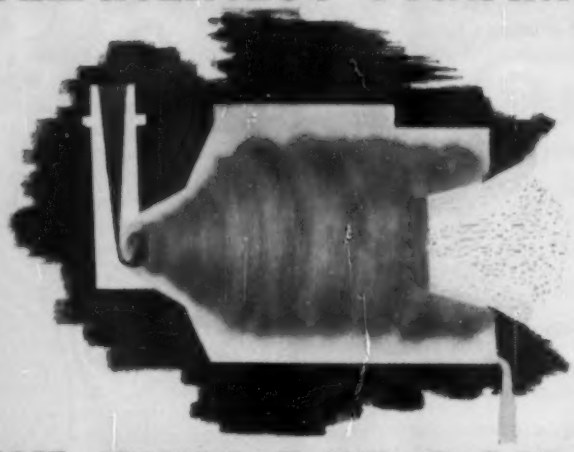
During World War II, Sam spent three years with the U.S. Army in the Pacific theater.

Starting with his present firm in 1946, Sam has worked as an estimator, as a project engineer and in his current position. He is a member of the American Society of Lubrication Engineers and the SAM maintenance group, and enjoys technical society activities.

For spare-time pursuits, Sam daubs at painting, hooks fresh-water fish, builds furniture and acts as adviser for a Junior Achievement Company. As you'll see from his article, he believes in a realistic approach to tough engineering problems met in today's plants.

# WITH STACK CLEANLINESS PARAMOUNT...

## EASTMAN KODAK SELECTED A



## B&W CYCLONE FURNACE BOILER

Faced with all of the problems common to power generation — fuel quality, fly-ash handling, unit availability, initial cost, maintenance cost — Eastman Kodak also has had to give major attention to the all-important factor of cleanliness at its Kodak Park Works. Absolute cleanliness is essential to the manufacture of sensitized paper and photographic film to maintain Kodak's high standard of product quality. Of equal importance is Eastman's outstanding reputation as a "good neighbor" to the thousands of citizens who have built their homes in the vicinity of Kodak Park.

After a long period of careful study and comparison of various types of steam generation units and firing methods — including many visits to utility and industrial power plants—Eastman Kodak engineers chose a B&W Pressurized Cyclone Furnace Boiler.

Here are some of the facts you will want to consider about the Cyclone Furnace:

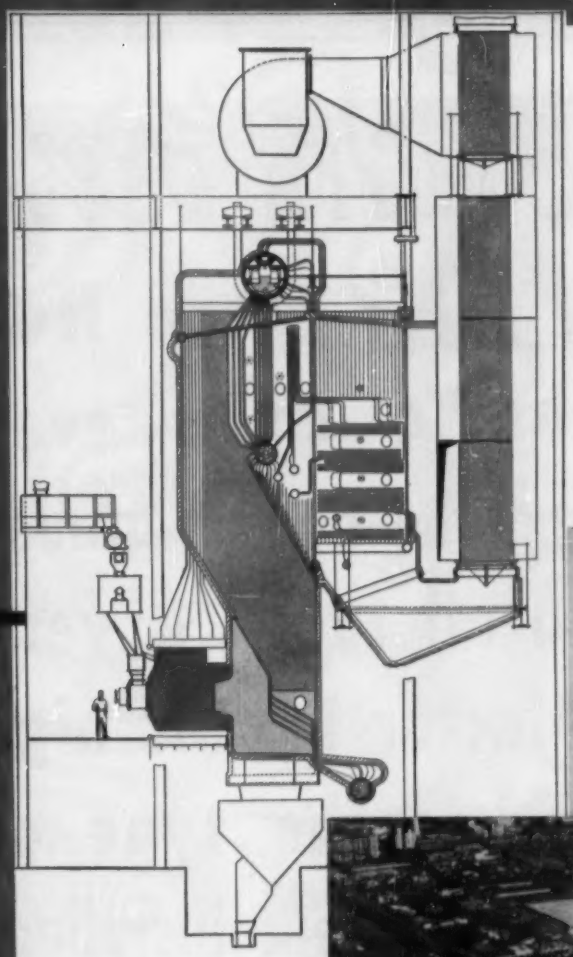
**FLY-ASH ELIMINATION**—The Cyclone's ability to melt most of the ash to slag in the furnace, holding fly-ash emission to an extremely low level, is vitally important. And with the use of collectors, the small amount of ash that escapes initial melting can be returned to the furnace and converted to readily disposable slag. In addition to cleanliness, this elimination of fly-ash represents substantial savings in ash control, handling and disposal.

**SAFER OPERATION**—With far fewer burners to light and very fast ignition, the Cyclone Furnace is safe, simple and easy to operate. Combustion controls are greatly simplified.

**BURNS A VARIETY OF FUELS ECONOMICALLY**—Designed to handle efficiently a wide range of coals including the poorer grades, the Cyclone Furnace is also ideally suited for burning oil or gas. Because it can be switched from fuel to fuel almost instantaneously, no time is lost and advantage can be taken of fuel price fluctuations.

**LESS MAINTENANCE**—As there are no pulverizers with motors, fans, ducts, and piping, and as there is so little ash in the flue gas to cause abrasive wear, maintenance is reduced, even when normally troublesome coals are burned.

Eastman Kodak is the most recent addition to the mounting list of large industrial and utility companies to turn to the cost-saving advantages of the Cyclone Furnace. B&W's technological knowledge gained through development of and experience with the Cyclone Furnace and many more major engineering advances in steam generation, is available to you at any time. The Babcock & Wilcox Company, 161 East 42nd Street, New York 17, N. Y.



B&W Pressurized Cyclone-Fired Radiant Boiler to be installed in the latest addition to Eastman's Kodak Park Works Power Plant, Burns & Roe, Inc., Engineers. Equipped with two Cyclones, the unit will generate 400,000 pounds of steam per hour and will burn coal or oil. Design pressure is 1575 psi. Pressure at the superheater outlet is 1425 psi, temperature is 900 F.

**BABCOCK & WILCOX**

BOILER DIVISION

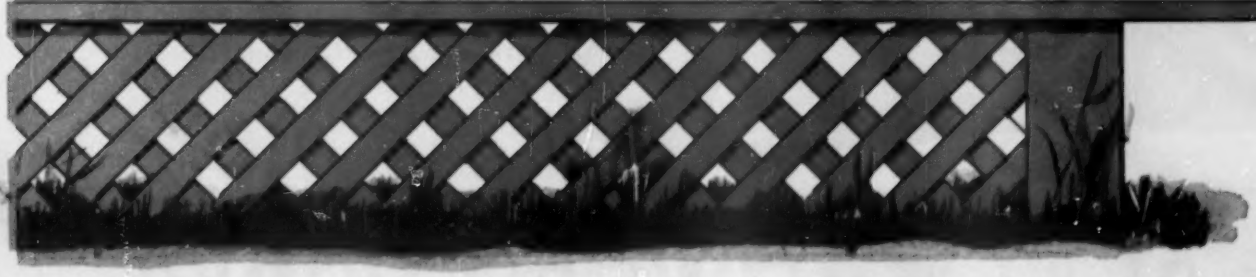
G-650

# Boilers with 95%+ Availability Are Not Uncommon Today . . . even those burning the poorer grades of coal and oil fuels. A very important factor in this high availability is the type of boiler cleaning system installed. Modern mechanized equipment, automatically controlled, pro-

vides uniform and effective cleaning of all surfaces on a scheduled basis. Many existing boilers with much lower availability resulting from surface and gas passage fouling can be improved greatly by a modest investment in modern **DIAMOND** cleaning equipment.

**DIAMOND POWER SPECIALTY CORP.**
**LANCASTER, OHIO**

*Diamond Specialty Limited • Windsor, Ontario*



valve values
PHOTO NEWS

# A "Valve School" Takes the Road

## *Factory-trained engineer conducts Valvemobile tour*

Nearly 250 key personnel each week in power, petroleum and industrial plants throughout the country hear the inside story of steel valves, their installation, operation, and maintenance when the Edward Valvemobile stops right in their own backyard.

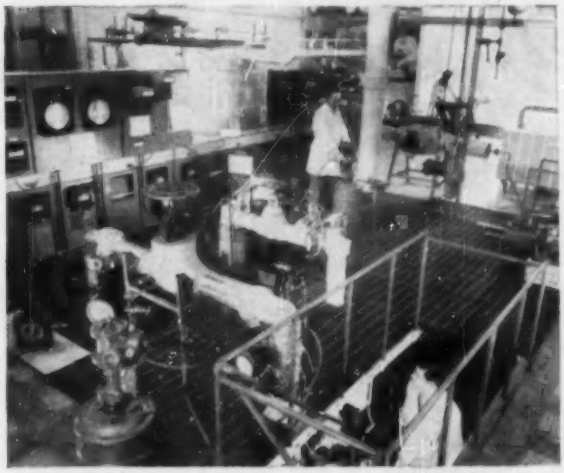
This 23-foot traveling "valve school" is crammed full of educational material to help valve users obtain better valve performance. Almost 40 sectioned valves literally give the inside story of valve operation. Diagrams, photographs, models and a color-slide lecture further describe valve procedures.

Edward developments which have become valve industry standards over the years are featured in the valvemobile, too. Inclined stem forged steel valves, Impactor handwheels, Equalizers for check and non-return valves; EValthrust yoke bushings; streamlined internal contours, and cored-out guide ribs are only a few of the Edward "firsts" displayed.

To conduct the program and answer questions, a competent valve engineer accompanies the Valvemobile on its visits. The engineer also demonstrates methods for repairing valves.

**Rockwell-built Edward Valves**

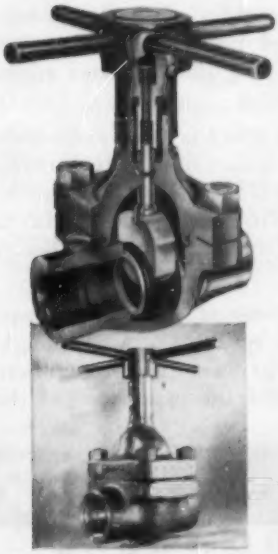
## *Valves for Super Critical Steam Studied Many Years at Edward*



Two of the super-heater loops and control panel in the Edward laboratories.

Recent contracts to build super critical steam electric generating units re-emphasize the importance of a continuing research project started years ago in the Edward laboratories. For example, using specially designed super-heater steam loops, Edward engineers have been testing valves at steam pressures to 5000 psi and temperatures to 1300F for the past five years. Data has been compiled continuously on distortion of various valve parts, ease of operation, packing performance and durability, creep or swelling of valve bodies, maintenance procedures, and other aspects of valve behavior in the super critical (above 3206.2 psi Abs.) range. Such foresight into valve problems, plus the ability to incorporate knowledge gained through research into new designs, keeps Edward ahead of today's technological applications.

## Abrasive Fluid Valve Developed by Edward for Oil Drilling Mudlines



Users report reductions in valve maintenance costs up to 80% on oil drilling mudlines that have been refitted with the new Rockwell-Built MUDWONDER abrasive fluid valve. Their enthusiastic acceptances again attest to the ability of Edward research and development engineers to find the facts and build their findings into a valve.

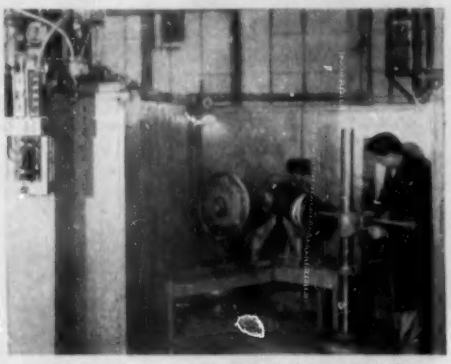
Erosion, corrosion, and the settling of solid materials which caused frequent shut-downs and numerous part replacements were some of the special problems brought to Edward early in 1948. MUDWONDER was the answer. Drilling rig operations in Oklahoma, Texas, and Louisiana have proved its superiority in controlling flow of drilling mud which often contains much sand, shale and corrosive clays.

If you have troublesome valve applications why not discuss them with Edward engineers? Their experience and facilities qualify them to solve difficult valve problems.

**GLOBE AND ANGLE STOP • FEED-LINE • BLOW-OFF • NON-RETURN CHECK • GATE • GAGE AND INSTRUMENT • RELIEF • STRAINERS**

# Technical Tips

## *Judging Radiographs of Steel Castings*



Above is new remotely controlled, pneumatically operated radiography apparatus designed by Edward engineers to improve the quality of radiographs and protect the operator from radiation.

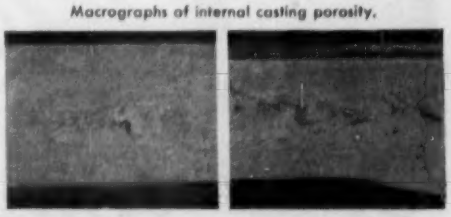
The ASTM Standard E71-47T sets up TENTATIVE INDUSTRIAL RADIOGRAPHIC STANDARDS FOR STEEL CASTINGS. The standards contain sample "x-ray type" films for seven types of steel casting defects including: (1) gas and blowholes, (2) sand spots and inclusions, (3) internal shrinkage, (4) hot tears, (5) cracks, (6) unfused chaplets and (7) internal chills. Each type of defect is described by three to six sample films which demonstrate different classes of soundness ranging through Class 5, the most severe.

Shrinkage defects are the ones most commonly developed by radiographic examination of steel valve castings. Comparing films for a particular casting under investigation with the ASTM standard films enables the engineer to determine the defect class. This standard, consequently, is a great aid in enabling all engineers to talk the same language when discussing radiographic soundness of castings.

A further comparison which is not given in the ASTM standard is the relation between a defect of any particular class with the actual cross-section of the casting. Shown below are etched cross-sections of two sample castings which show Class 2 and 4 shrinkage defects. An examination of these along with standard radiographic film helps an engineer to more clearly form a mental image of the defect he is considering.

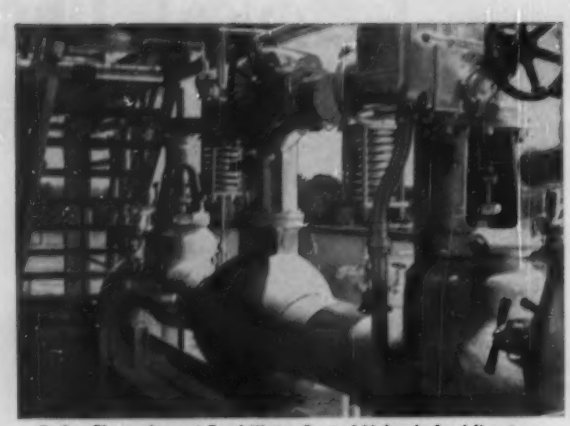
Interpreting radiographs is aided by set standards but establishing the scope of the radiographic examination within practical and economic limits requires experience. A quarter century of perfecting techniques has given Edward casting experts this "know-how."

Macrographs of internal casting porosity.

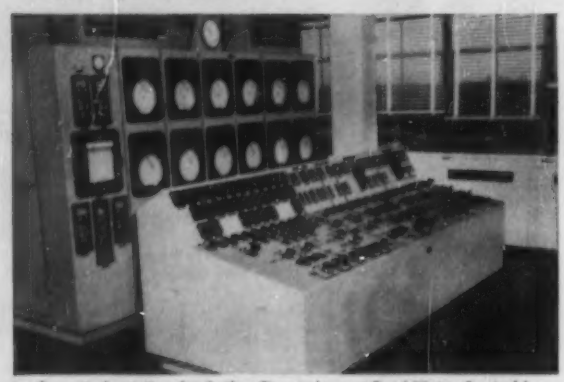


Class 2 shrinkage | Class 4 shrinkage

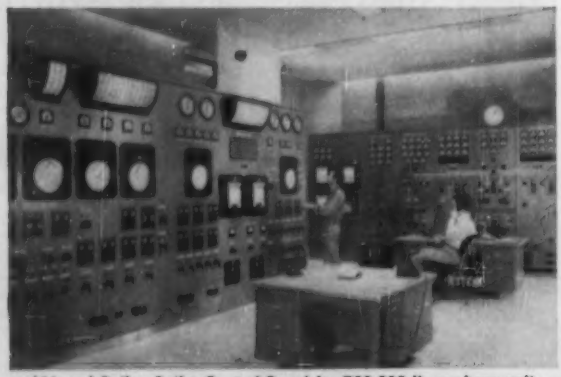
**Edward Valves, Inc.**
Subsidiary of
**ROCKWELL MANUFACTURING COMPANY**
**EAST CHICAGO, INDIANA**



Bailey Three-element Feed Water Control Valve in feed line to a 450,000 lb per hour boiler.

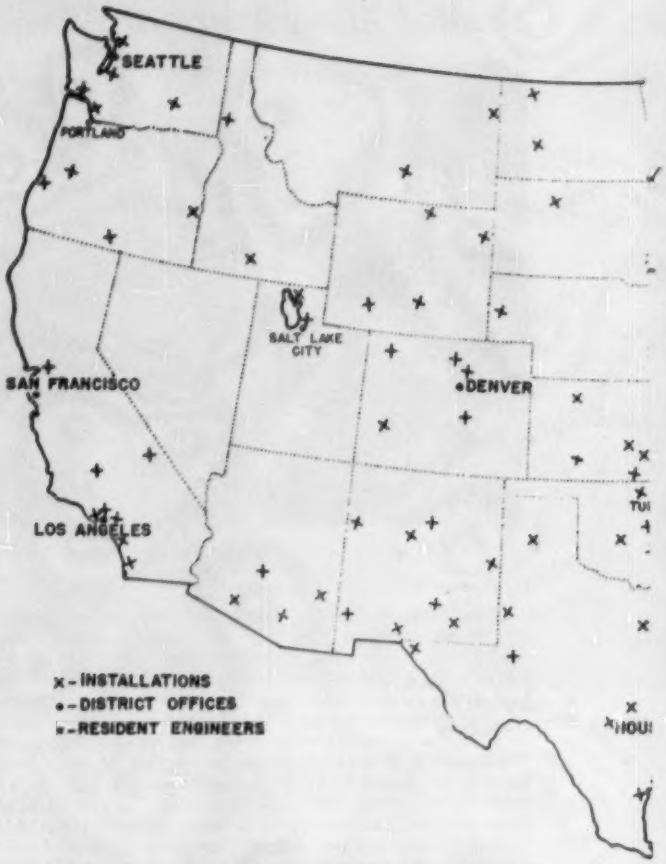


Operator's station for Bailey Three-element Feed Water Control is located in this compact control room.



(Above) Bailey Boiler Control Panel for 750,000 lb per hour unit including Three-element Feed Water Control.

(Below) Bailey Control Valve in feed water line to above unit.




# Here's Proof—

## Bailey Is Your Best Buy in

More than 1000 large boiler units are equipped with Bailey Three-element* Feed Water Control for close regulation of drum level, added safety, and added efficiency.

That Bailey is better than a 2 to 1 favorite against the combined total of all other makes used in this service is borne out by checking the 173 steam-electric stations listed by Electrical World in its design issues of May 8, 1950 and April 7, 1952. No wonder we can say Bailey is your best buy.

Such an endorsement by users of power equipment doesn't just happen. It's the result of carefully weighing all factors: design superiority, accuracy of operation, dependability in service, and the experience of the

**BAILEY METER**

1036 IVANHOE ROAD

*Complete Controls for*

# 1000 times!

## Feed Water Control

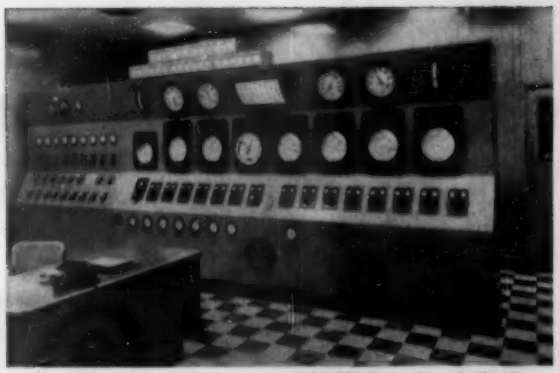
manufacturer in building and servicing this type of equipment.

That's why you should check with users before you buy. And you'll find a Bailey user near you. We couldn't spot over 1000 installations on one small map—but from those we were able to show, you can get some idea of Bailey's universal popularity—and how easy it is to get service with a minimum of travel time and expense. Call your nearest Bailey Office—they will be glad to arrange an inspection tour for you. And if you want catalog information, including a list of users, write for Bulletin 105-C Bailey Meter Company. A-123-2

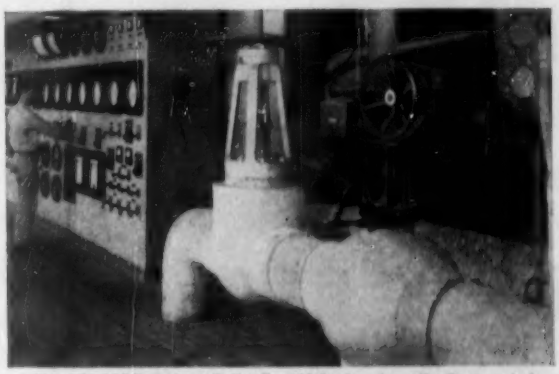
*The three elements are—1. Steam Flow from Boiler
2. Water Flow to Boiler
3. Water Level in Drum

**COMPANY**
CLEVELAND 10, OHIO
*Steam Plants*

COMBUSTION
FEED WATER
TEMPERATURE
PRESSURE
LIQUID LEVEL
FEED PUMPS



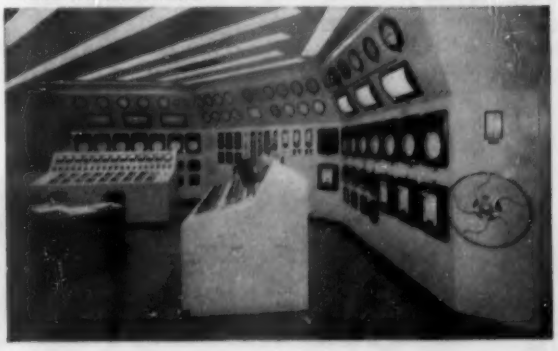
This control room, which serves a 500,000 lb per hour boiler, includes an operator's station for Bailey Three-element Feed Water Control.



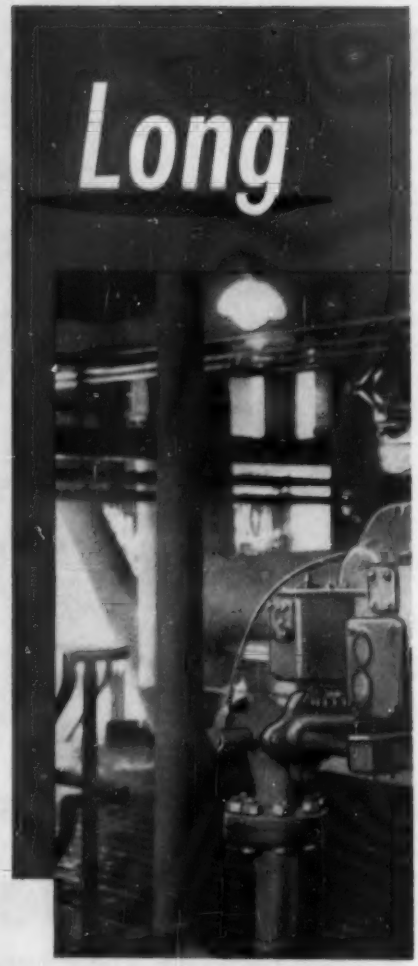
This 575,000 lb per hour Bailey Feed Valve is automatically operated by Three-element Feed Water Control.

(Above) Operaters' stations for Bailey Three-element Feed Water Control are concentrated in this centralized control room for three 250,000 lb per hour boilers.

(Below) Three-element Feed Water Control is part of the complete Bailey Control System operating two 500,000 lb per hour boilers from this control room.



# VULCAN *because of...*




**DUAL MOTOR DRIVE**

Vulcan uses two motors. One extends and retracts the lance. The other rotates it. Motors may be air or electric. Speeds are independently adjustable.

**JET AND LANCE DESIGN**

Vulcan offers jets tailored to the job—straight bore or venturi; and angled to reach specific surfaces. Jets normally rotate while traversing, but may traverse only or oscillate through any angle. Lances from opposite sides of the furnace may fail to "meet" by as much as 12 feet, yet clean thoroughly.

**CHOICE OF BLOWING MEDIUM**

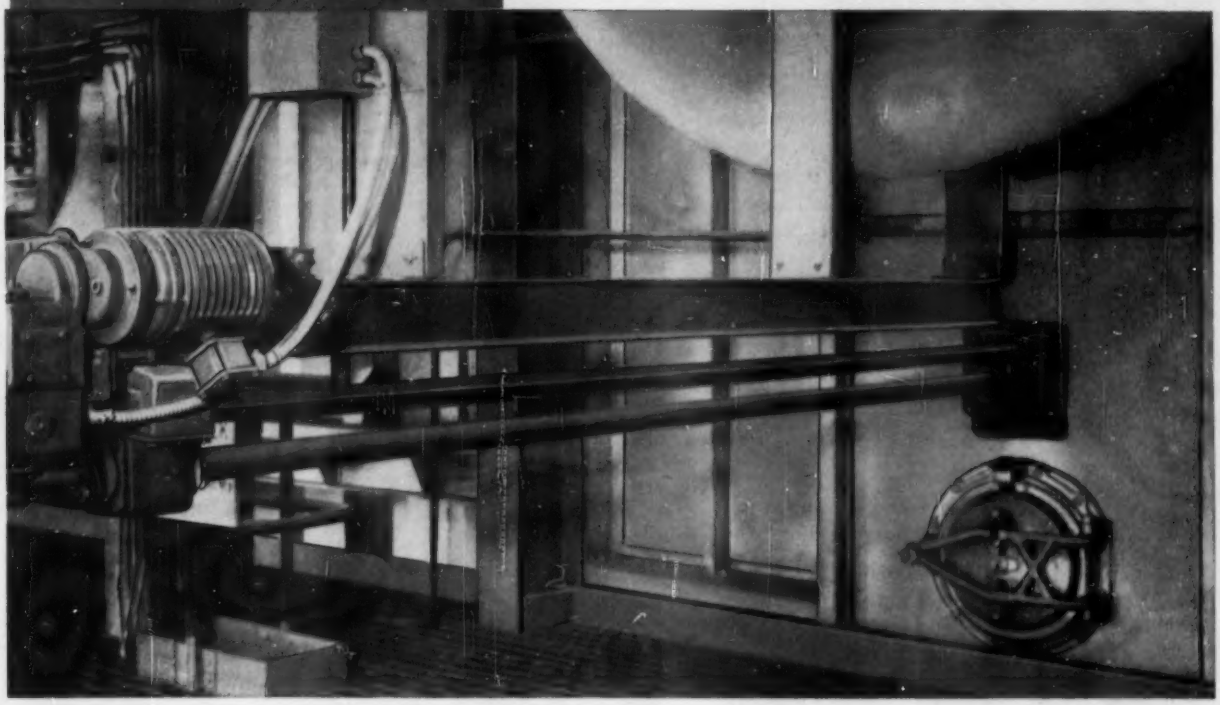
You can blow with any medium—air, steam or water, or any combination of them—*without change of equipment.*

**CHANGE OF PACE**

Two motors allow stop-and-go indexing with uniform rotation—or fast-and-slow change of pace. On "stop and go," the lance is stopped and rotated to clean the tubes—then sped across the open areas to the next row of tubes. On "fast and slow," the lance is slowed to clean the tubes, and sped while passing open areas. In each case, the result is a saving of blowing medium.

**VULCAN *Automatic***

# Retracts clean better



Vulcan Long Retracts clean better—with fewer outages, at lowest cost. They are engineered for optimum performance under varying conditions. They work equally well at any angle. They give you the benefit of dual-motor operation—one motor to traverse the lance, a second to rotate it. *Rotation is always in the same direction.* Repeated cleaning cycles result in an infinite number of double-helix paths that continually broaden the cleaning coverage. Lances can pass through as little as four inches of tube clearance. Write for Bulletin 1002.

**COPES-VULCAN DIVISION**

CONTINENTAL FOUNDRY & MACHINE COMPANY

**ERIE 4, PENNSYLVANIA**

**Soot BLOWERS**

## "Dated" instruments drain away dollars

Instruments can become outmoded . . . just like automobiles and ideas. Progressive instrument development is constantly making many older designs obsolete . . . and such obsolescence can be a steady drain on profits.

### Modern instruments save money

Honeywell engineers are proving this fact every day—in a growing number of plants, on all types of processes. Where out-of-date controls have been replaced by modern Honeywell instrumentation, economy-minded engineers and management men have really opened their eyes. And with good reason, for—

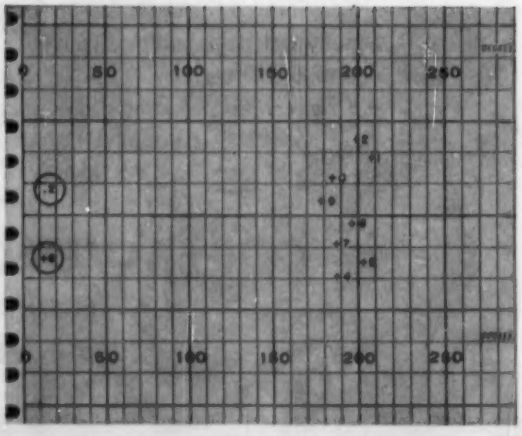
- Modern Honeywell instrumentation saves labor. Centralized control, automatic time-cycle systems, and other recent control concepts save countless wasted steps . . . reduce routine man-hour expenditures.
- Modern Honeywell instrumentation cuts maintenance costs. It affords longer, uninterrupted operation . . . is designed for easy service . . . requires minimum attention.
- Modern Honeywell instrumentation reduces rejects. It maintains the tighter process tolerances demanded by today's more exacting specifications.
- Modern Honeywell instrumentation improves product quality. Precision measurement and control remove any chance of error or guesswork in critical processes.
- Modern Honeywell instrumentation makes cost accounting more accurate than ever before. Everything is a matter of record.

### An investment that really pays off

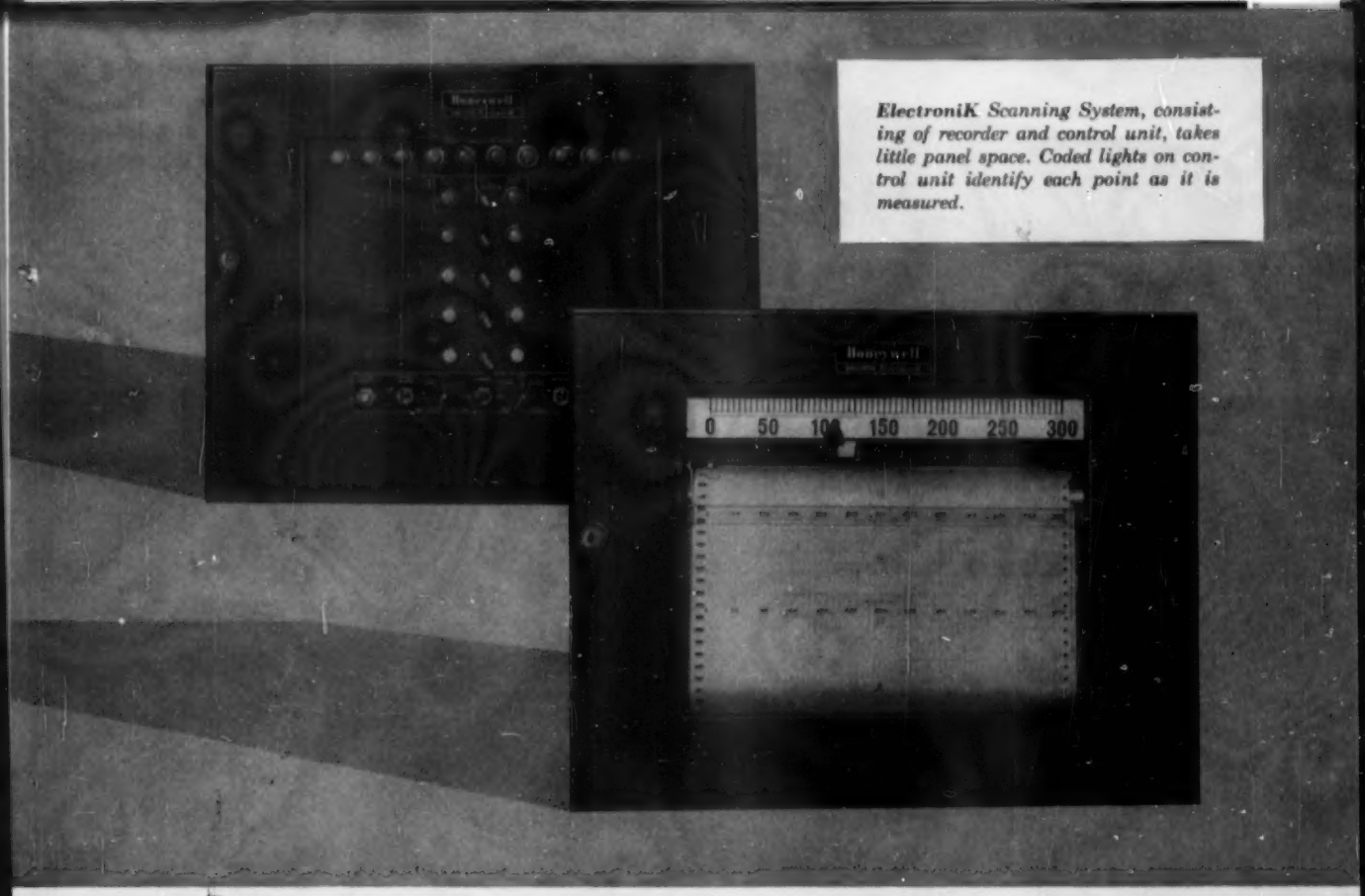
Just being "instrumented" is not enough. You can get more out of your instrument dollar, from both a product and service standpoint, with Honeywell instrumentation . . . the ultimate in engineering and design . . . insurance for your equipment investment.

Replacing with Honeywell is one of the best ways to invest your modernization appropriation. A Honeywell application engineer will gladly survey your present plant instrumentation . . . give you a practical recommendation that will make dollars and sense. Give him a call . . . he's as near as your phone.

# This economical, versatile system monitors up to




*Sample chart shows how all 270 points are clearly identified on the record.*




*ElectroniK Scanning System, consisting of recorder and control unit, takes little panel space. Coded lights on control unit identify each point as it is measured.*

# 270 plant temperatures

THE TIME, expense and uncertainties of periodic tours to check temperatures at potential "hot spots" in the plant can be materially reduced by the *ElectroniK* Scanning System. This instrumentation makes temperature monitoring completely automatic and efficiently centralized. A single instrument watches 270 different temperatures in bearings, oil lines, boiler tubes, pumps . . . anywhere you can install a thermocouple.

Because of its exceptionally large capacity, the *ElectroniK* Scanner does the work of up to 16 old-style instruments . . . affords effective overheat protection at low cost per point.

**It's fast**—scans through successive thermocouples at speeds up to one second per point. Each point is checked at 4½ minute intervals . . . far more frequent than the best manual checks.

**It signals overheat.** Annunciator contacts are actuated whenever any point in a bank of nine exceeds a preset limit. Different limits can be set for each bank.

**It's versatile.** At the flick of a switch, the operator can choose:

1. Continuous recording of all 270 points, with positive identification of each.
2. Recording of only those points which exceed a preset limit.
3. Continuous scanning without recording.
4. Selective recording or scanning of pairs of nine-point banks.

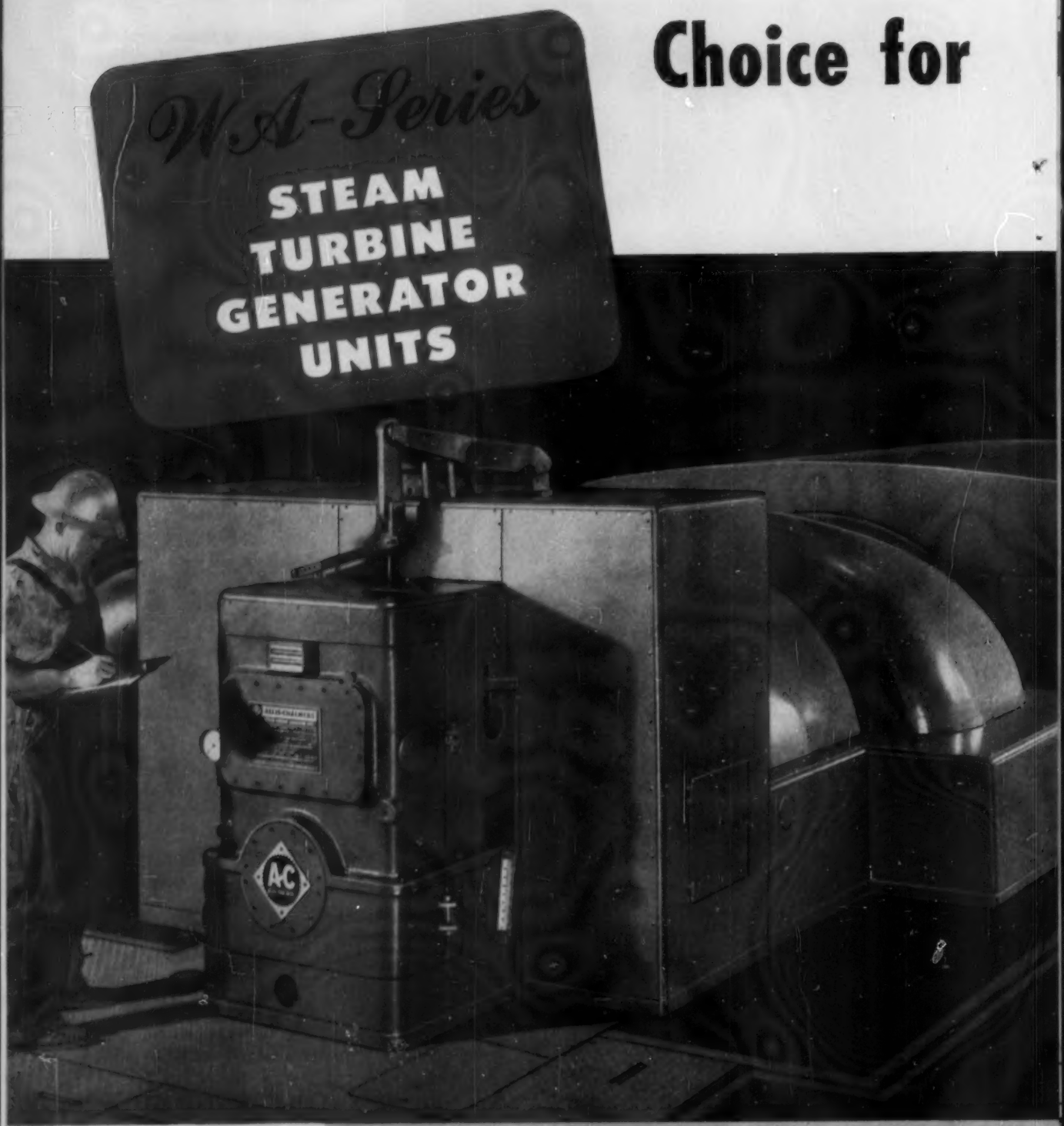
Models with less than 270 points are available to meet your individual needs. Your nearby Honeywell sales engineer will be glad to discuss your own plant's requirements . . . and he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.

● **REFERENCE DATA:** Write for Data Sheet No. 10.0-9, "*ElectroniK* Scanning System."

MINNEAPOLIS
**Honeywell**
BROWN INSTRUMENTS
*First in Controls*

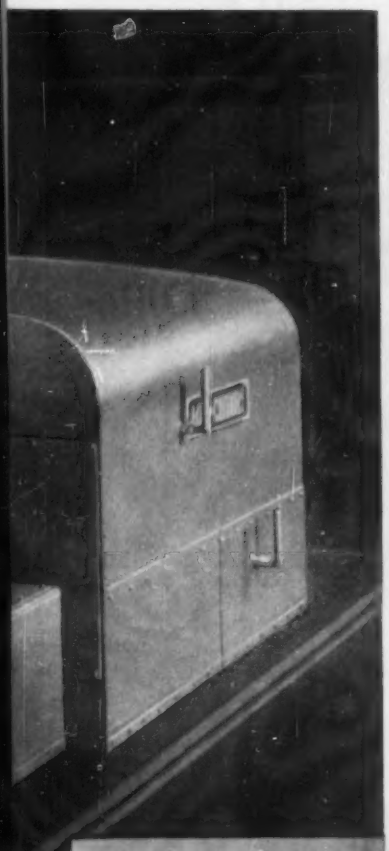
# Choice for




COMPLETE POWER PLANT at Tuscola includes three boilers and two WA-Series steam turbine generator units, shown above. Allis-Chalmers also supplied condensers and condensate pumps for the plant.

# ALLIS-

# New $44,000,000 Petro-chemical Plant



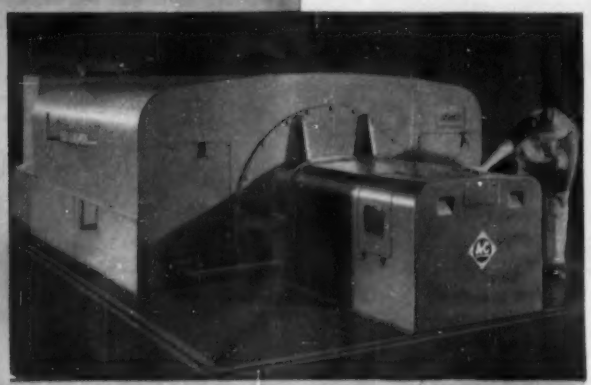
## Two units generate power as by-product from steam required for processing natural gas

**NATIONAL PETRO-CHEMICAL CORPORATION'S** new Tuscola, Illinois, plant takes up to 425 million cubic feet of natural gas from the adjacent Panhandle Eastern pipeline, extracts 10 million cubic feet of ethane for cracking into valuable industrial chemicals, and returns the gas to the pipeline for transportation to big city customers.

To synthesize this huge amount of ethane into ethylene, hydrogen, and later into other useful components, fractionation and low temperature separation are used. The processes require 600,000 pounds per hour of steam, which is produced at 625 psig, 750 F.

Two condensing, automatic extraction WA-Series steam turbine generators are utilized to produce 10,000 kw of power from the steam before it is delivered into plant processes. The steam is delivered directly into the high temperature side of the automatic extraction impulse turbines, from which it is extracted at 65 psig for use in the plant. Each turbine generator unit is equipped with a housing-type, air-cooled generator and exciter. The entire units are carefully engineered and manufactured to operate as integrated units, 24 hours a day, 7 days a week.

WA-Series steam turbine generator units match the most modern plant design to provide high efficiency power or process steam. They are available in condensing or non-condensing types in NEMA ratings 2000 kw and larger. Bulletin 03B7654 gives complete facts. For your copy just call your nearby A-C office or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-4477



OUTBOARD END of one unit shows exciter housing.

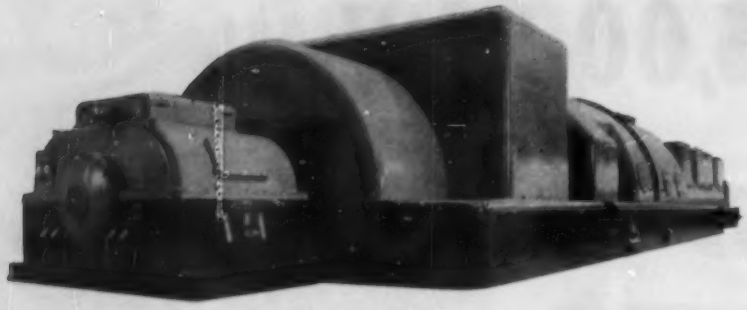
### Simplified Installation and Maintenance

Every detail of WA-Series steam turbine generator units is designed for maximum simplicity and maintenance. Three-bearing construction, above-the-floor oil piping, and bracket-bearing, housing-type air-cooled generator are some of the features that result in a compact unit with simplified installation requirements. Turbine and generator are shipped with their rotors locked in place, further minimizing installation time.

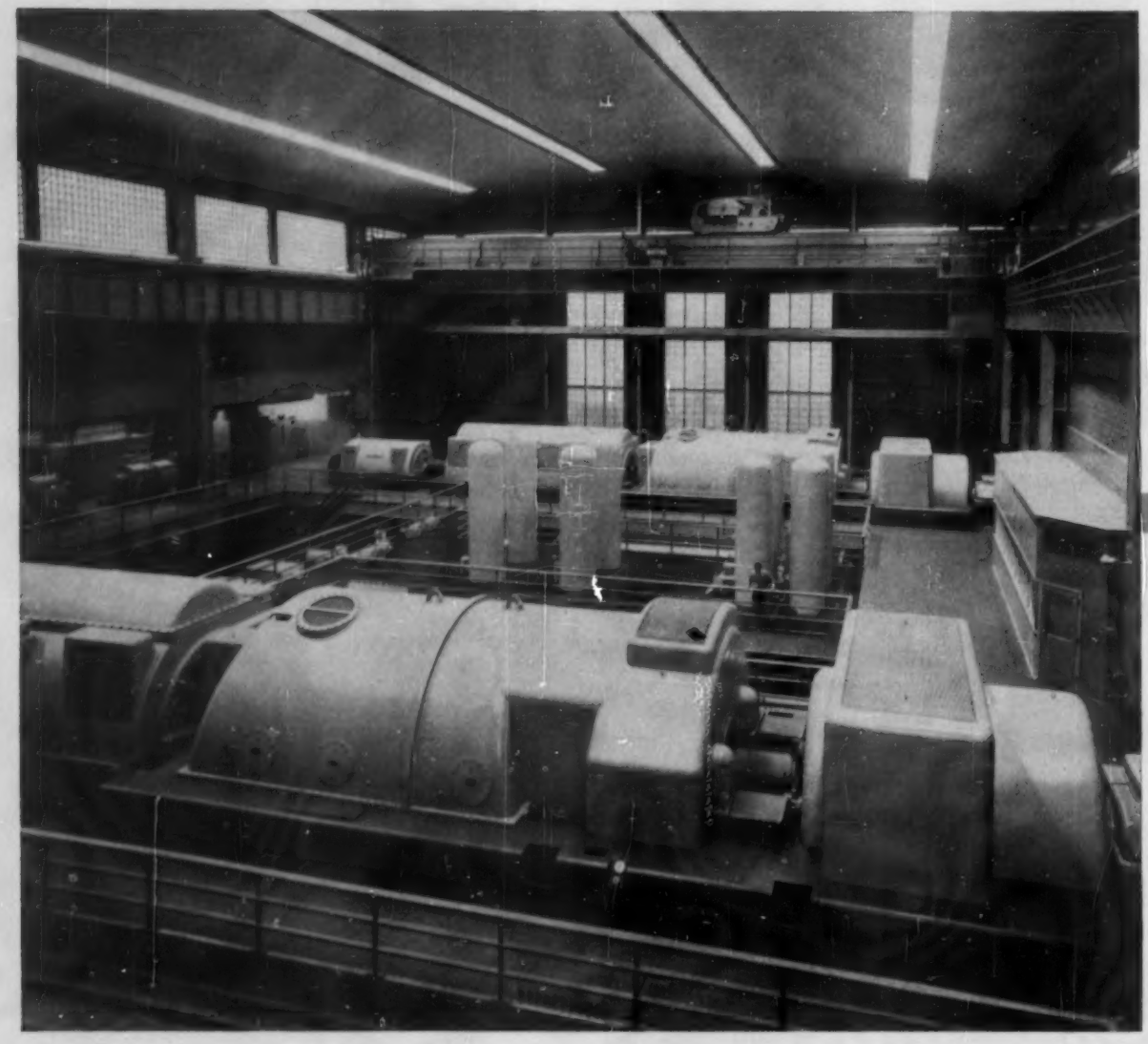
Maximum reliability is assured by labyrinth spring-back steam seals throughout, removable external glands, high chrome alloy steel buckets and nozzles, and a time-proved governing system.

# CHALMERS

A-C ALLIS-CHALMERS



# Hottest




*support*

*Junior*

*Achievement*

Junior Achievement Week
January 30-
February 5, 1955


Two General Electric 145,000 Kw tandem-compound, triple-flow turbine-generator units at the New Kearny Generating Station of Public Service Electric and Gas Company (New Jersey). They are designed for steam conditions of 2350 psig; 1100 F initial, and 1050 F reheat. At the top is a close-up of one of these high-temperature turbines at the New Kearny Generating Station. These two units produce enough electric power to supply a city of 800,000 people.

# steam turbines in the U.S. get effective, long-lasting lubrication with

# GULFCREST OIL

Driven by steam so hot that the stainless steel pipes carrying it glow dark red and with their huge turbine rotors spinning at 3600 rpm, this country's hottest steam turbines require safe, long-lasting lubrication.

Entrusted with the vital job of providing this kind of lubrication is Gulfcrest—the oil that is super-refined by Gulf's exclusive Alchlor Process.

Gulfcrest Oil's unmatched record of outstanding performance in every type and make of steam turbo-generator is a guarantee of efficient protection for the nation's hottest units for many years to come.

The next time you fill a turbine system, make it a fill for the most effective, longest-lasting protection. Specify Gulfcrest—the world's finest turbine oil. Call your nearest Gulf office today and have an experienced Gulf Sales Engineer recommend the proper grade.

**GULF OIL CORPORATION**

**GULF REFINING COMPANY**

1822 Gulf Building, Pittsburgh 30, Pa.

GULF

*The finest petroleum products for your every need*

# LOOK WHAT'S HAPPENING TO BOILER WATER GAGES.

●There's a "new look" in water gages for high pressure boilers. You'll find it in every new YARWAY Flat Glass Boiler Water Level Gage.

YARWAY design and development engineers have made *twelve distinctive improvements* in YARWAY gages. All contribute to improved water gage service, longer water gage life.

**Better Illumination**—improved mercury vapor illumination makes meniscus "shine like a star".

**Body Improvements**—flanged connections and expansion bends eliminate stuffing boxes and *prevent distortion*—separated design in four-glass inserts permit freedom for expansion—stainless steel facing for gasket recess provides corrosion proof surface for the higher pressures—close machining tolerances insure top quality.

**Improved Gaskets and Mica**—"Frelon" gaskets are coated with a special compound to prevent sticking at disassembly—wire inserts for the higher pressures give "Frelon" gaskets greater strength—thicker mica for the higher pressure gages.

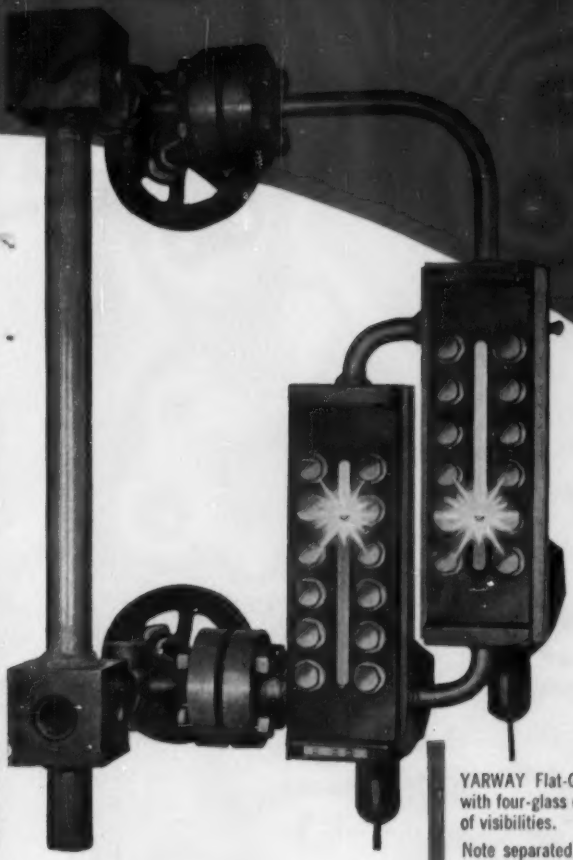
**"Floating Assembly" Covers**—improved capscrews have wider shoulders at face of body—improved spring cones reduce spring cone stresses.

**Better Valves**—YARWAY Welbond gage valves have integral stellite seats and stainless steel stems—Welbond water column shut-off valves have lock-open device.

YARWAY Gages are the "gages to see" on all new boiler units or replacements in high-pressure installations.

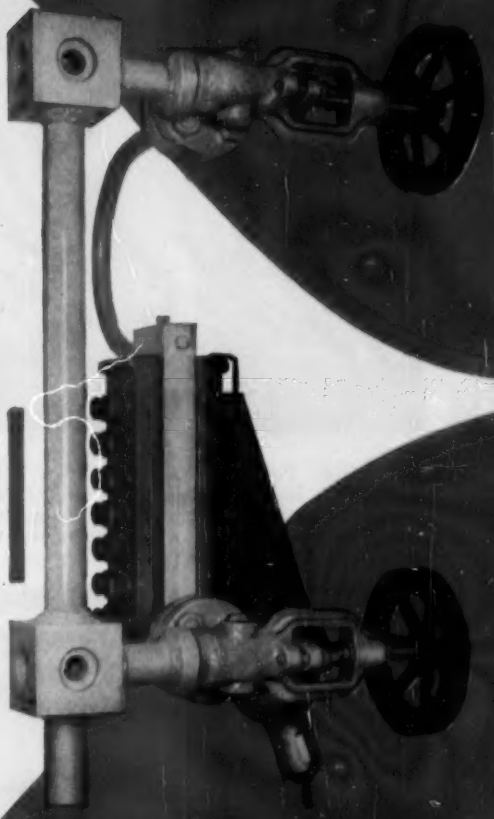
Write now for new YARWAY Bulletin WG-1812.

**YARNALL-WARING COMPANY**
100 Mermaid Avenue, Philadelphia 18, Pa.
BRANCH OFFICES IN PRINCIPAL CITIES

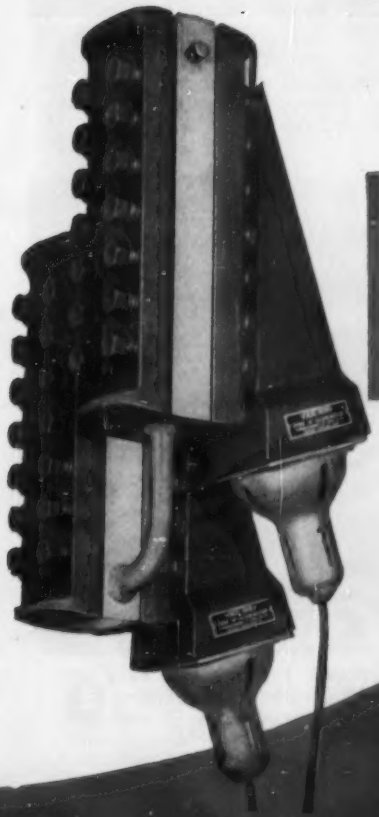


YARWAY Flat-Glass Water Gage Assembly with four-glass double insert for long ranges of visibilities.

Note separated design, interconnecting expansion loops, flanged connections (1½" tie-bar-type circulating water column) and Type "M" Illuminators that make meniscus at water level "shine like a star".



YARWAY Single Insert type gage for medium range of visibilities. Note expansion loop and flanged connections. YARWAY Welbond Gage Valves assure highest dependability in high-pressure service.

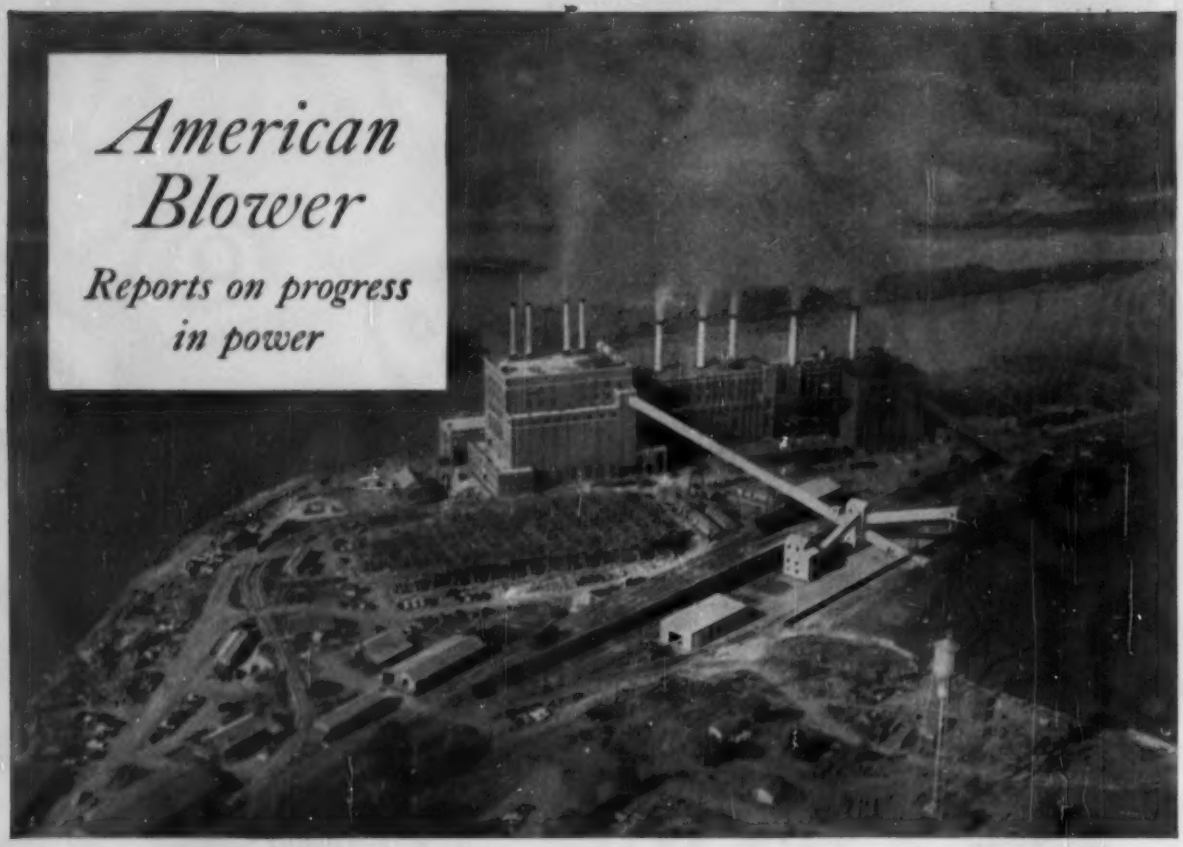


Close-up of YARWAY Type "M" Illuminators on above 4-glass insert assembly. The blue-white illumination is visible for distances up to 125 ft. and is especially effective in penetrating deposits on gage glasses, dust particles in the air and extraneous light.

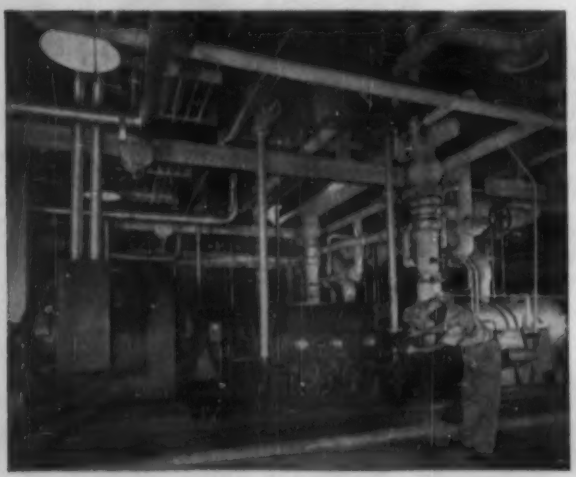
YARWAY

*water columns and gages*

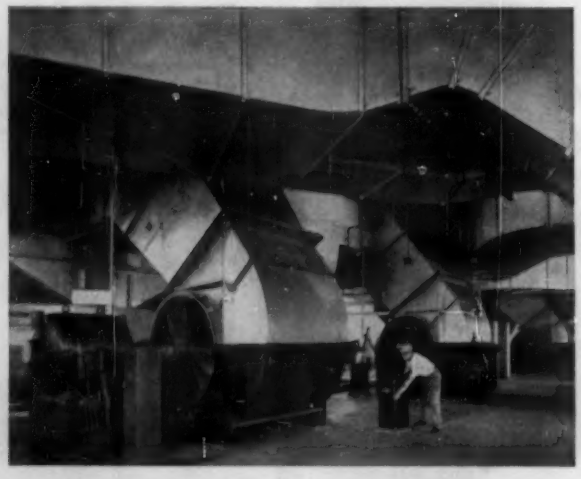
# From a tiny trickle to a mighty




1. Duke Power's Buck Plant (above) near Salisbury, N.C., increased capacity by 250,000 kw in 1953. Two new generating units, recently completed, also added 266,000 kw to the Riverbend Plant near Charlotte, N.C. At the Dan River Plant near Draper, N.C., a new 150,000 kw unit is under construction, to be completed in 1955. Two other Duke Power plants are: Cliffside near Shelby, N.C. and Lee near Greenville, S.C.

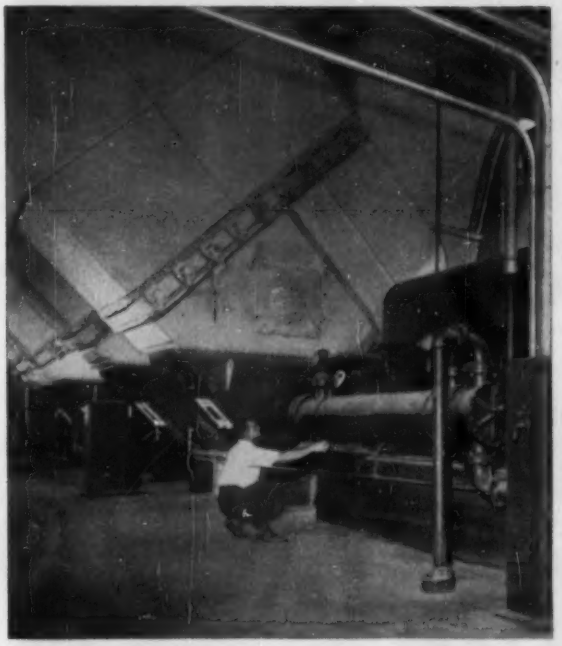


2. American Blower Gyrol Fluid Drive – type VS, class 6 – provides smooth, adjustable speed control of a boiler feed pump. It is coupled with a 1750 hp motor in the Buck Plant.

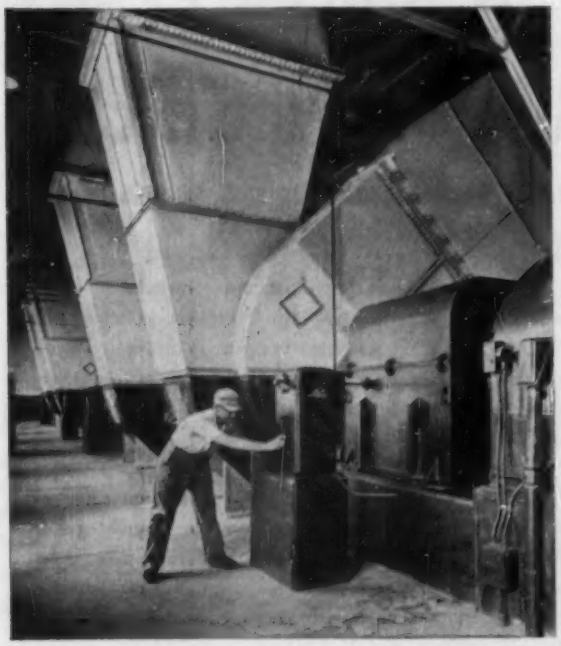


3. Four American Blower Forced Draft Fans are installed in Duke Power's Riverbend Plant. Each has a capacity of 143,000 cfm @ 100°F @ 1180 rpm @ 406 bhp.

# 2,211,000 kw–that's Duke Power!



4. Duke Power installed these four American Blower Induced Draft Fans at the Buck Plant. Each is driven through a type VS, class 4 American Blower Gyrol Fluid Drive.



5. Rated @ 234,000 cfm @ 296°F @ 637 bhp, each of these four American Blower Induced Draft Fans at the Riverbend Plant is coupled with an American Blower Gyrol Fluid Drive.

**In its tremendous expansion, another leading power company chooses American Blower equipment**

On April 1, 1904, a power line from a small hydroelectric plant at India Hook Shoals, S.C., was completed to Rock Hill, S.C. This was the simple beginning of the Duke Power Company system . . . a system that today serves over half a million customers in a 20,000-square-mile area in the Piedmont Carolinas – supplying electricity for some 35% of the nation's textile spindles . . . a system that through continued expansion will have an estimated capacity of 2,211,000 kw in 1955!

Planning far ahead of customers' needs is basic to this progressive, investor-owned utility. During the eight years from 1946 through 1953, Duke Power spent $231,000,000 to expand facilities, including $6,000,000 for the South's first steel-tower 230 kw line. Present plans call for additional expenditures, through 1964, of $30,000,000 annually. Duke Power is surging ahead with a dramatic fifty years of generating electricity behind them!

Supplying dependable air handling equipment and Gyrol Fluid Drives is the important part American Blower plays in Duke Power's tremendous expansion. (See pictures and captions.) It's a big role, one that is being duplicated in leading power and industrial plants everywhere.

If *your* future calls for expansion or moderniza tion, talk over your plans and problems with an experienced American Blower representative. He can recommend efficient, economical equipment– including Mechanical Draft Fans, Fly Ash Precipitators, Dust Collectors, Heavy Duty Steam Coils and Gyrol Fluid Drives for boiler feed pump and fan control. Call your nearest American Blower Branch Office.

**AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN**
**CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO**
Division of American Radiator & Standard Sanitary Corporation

**AMERICAN BLOWER**

*Serving home and industry:*

AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

OPERATOR CHECKS READINGS OF HAYS ELECTRONIC OXYGEN METER WHEN BURNING MULTIPLE FUELS

# THESE INNOVATIONS IN BOILER PLANT INSTRUMENTATION ARE MAKING NEWS

## New instruments meet demands of outdoor boilers, space saving, greater speed of response, multiple fuel firing

Boiler plant instrumentation is changing.

Electrically operated combustion control is being used more and more as larger numbers of outdoor boilers are installed. For all-weather operation electric combustion control is preferred since electricity doesn't freeze, is readily available, doesn't require expensive compressors and dryers, allows maximum freedom in the location of the control room.

More miniature indicators and control stations mounted on console or graphic panels are appearing as operators demand more instruments in less space. All essential information is concentrated for fingertip control while supplementary indications and recordings are located on adjacent standard size panels.

Electronic instruments are becoming more numerous because they give faster speed of response and greater accuracy, can be placed anywhere, eliminate pressure lines into the panel.

Oxygen recorders have become standard equipment where fuel flexibility is desired. Unlike other combustion guides, oxygen measurement is unaffected by the varying Hydrogen-Carbon ratios of different fuels, hence gives the *only* accurate check where more than one fuel is being burned.

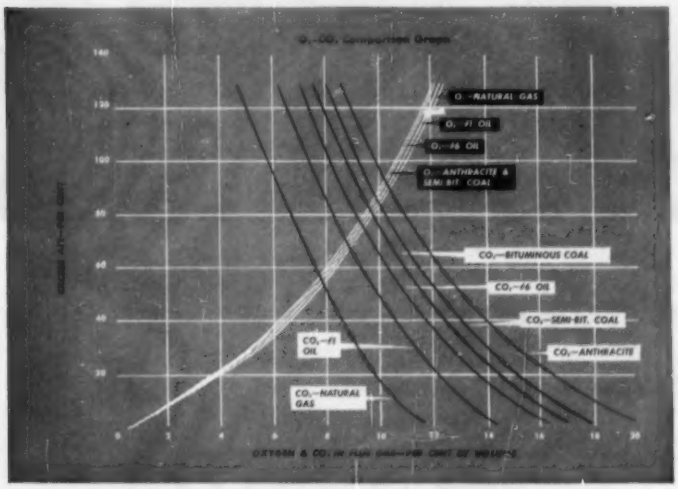
In response to these trends The Hays Corporation offers the complete, modern boiler plant instrumentation line including electric combustion control; highly visible, internally illuminated miniature indicators; custom-made panels; new electronic mercury-less flow meters; new 1, 2 and 3 element electronic feedwater control; combustion guide instruments of every type including the Magno-Therm electronic oxygen recorder.

Write for free bulletins on any of these products—available from The Hays Corporation, Michigan City, Ind.

**MORE INSTRUMENTS IN LESS SPACE** have been accomplished with Hays miniature indicators on a console panel. They indicate any variable. Transmission is either electrical or pneumatic on highly visible, internally illuminated 5" scales. Hays console panels are custom-made to conform to individual specifications.

**OUTDOOR BOILERS,** which eliminate the need for expensive enclosures, demand all-weather dependability from controls. Hays all-electric combustion control doesn't freeze, eliminates expensive dryers and compressors.

**ELECTRONIC INSTRUMENTS** have greater speed of response and accuracy. Here operator inspects transmitter of new Hays electronic mercury-less flow meter. Recorder can be located at remote distances from transmitter.




**IN BURNING MULTIPLE FUELS** only $O_2$ gives an undistorted picture of excess air present in flue gas — as demonstrated by this graph.

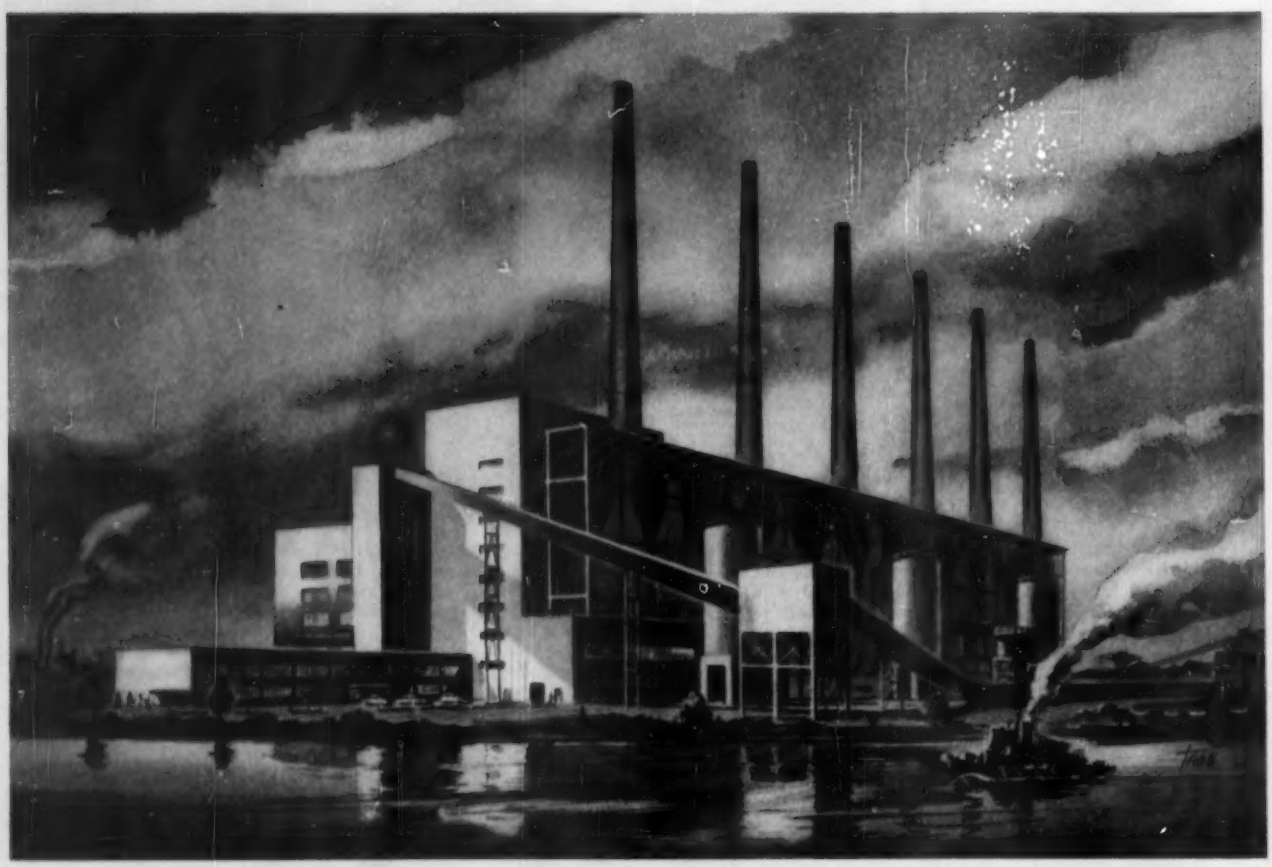

Automatic Combustion Control
Boiler Panels • Hays-Penn Flowmeters
Veriflow Meters and Veritrol
Gas Analyzers • Draft Gages
Combustion Test Sets • $CO_2$ Recorders
Electronic Oxygen Recorders
Electronic Flowmeters
Electronic Feed Water Controls
Miniature Remote Indicators

THE hays CORPORATION

MICHIGAN CITY 3, INDIANA

# ...and now

# 2,000,000



Reddy Kilowatt

## 3,250,000 KILOWATTS BY 1957

When the new unit goes into operation, capacity of the Detroit Edison system will total three and a quarter million kilowatts—more than double that of ten years ago. This will be the third unit to be installed at River Rouge—the other two, with a capacity of 260,000 kw each, will go on line in 1956.

* *Trade mark character used by permission of Reddy Kilowatt, Inc.*

# pounds per hour!

***Detroit Edison to make power generation history at new River Rouge Plant . . . with a tradition-shattering high-pressure turbine of 300,000 kw capacity, served by a Foster Wheeler Steam Generator, the largest in the world!***

IT TAKES COURAGE and foresight to break with tradition—to plan and execute a power project which far surpasses anything ever done before. But the break has been made and a thrilling new chapter in power plant history is now being written. It's the story of Detroit Edison's River Rouge Plant.

Here, late in 1957, the largest steam turbine-generator in the world will go into operation. Rated at 300,000 kw, it will set completely new standards of efficiency and economy—producing a kilowatt of electricity for less than three fourths of a pound of coal!

Steam for the giant turbine will be supplied by a single Foster Wheeler steam generator with a capacity of two million pounds per hour at 2450 psi pressure and 1050 F at the superheater outlet. Reheat facilities will resuperheat the steam to 1000 F after it has passed through the initial stages of the turbine. This, the largest single steam generator ever to be built, represents a great forward step in power plant engineering.

The awarding of this record-making order is therefore a gratifying vote of *confidence* from Detroit Edison. Past achievements show that this confidence is well placed. With more than fifty years of experience in steam generation, and the finest modern manufacturing facilities in three large plants, Foster Wheeler welcomes the opportunity to help Detroit Edison make history at River Rouge. *Foster Wheeler Corporation, 165 Broadway, New York 6, N.Y.*

**FOSTER WHEELER**

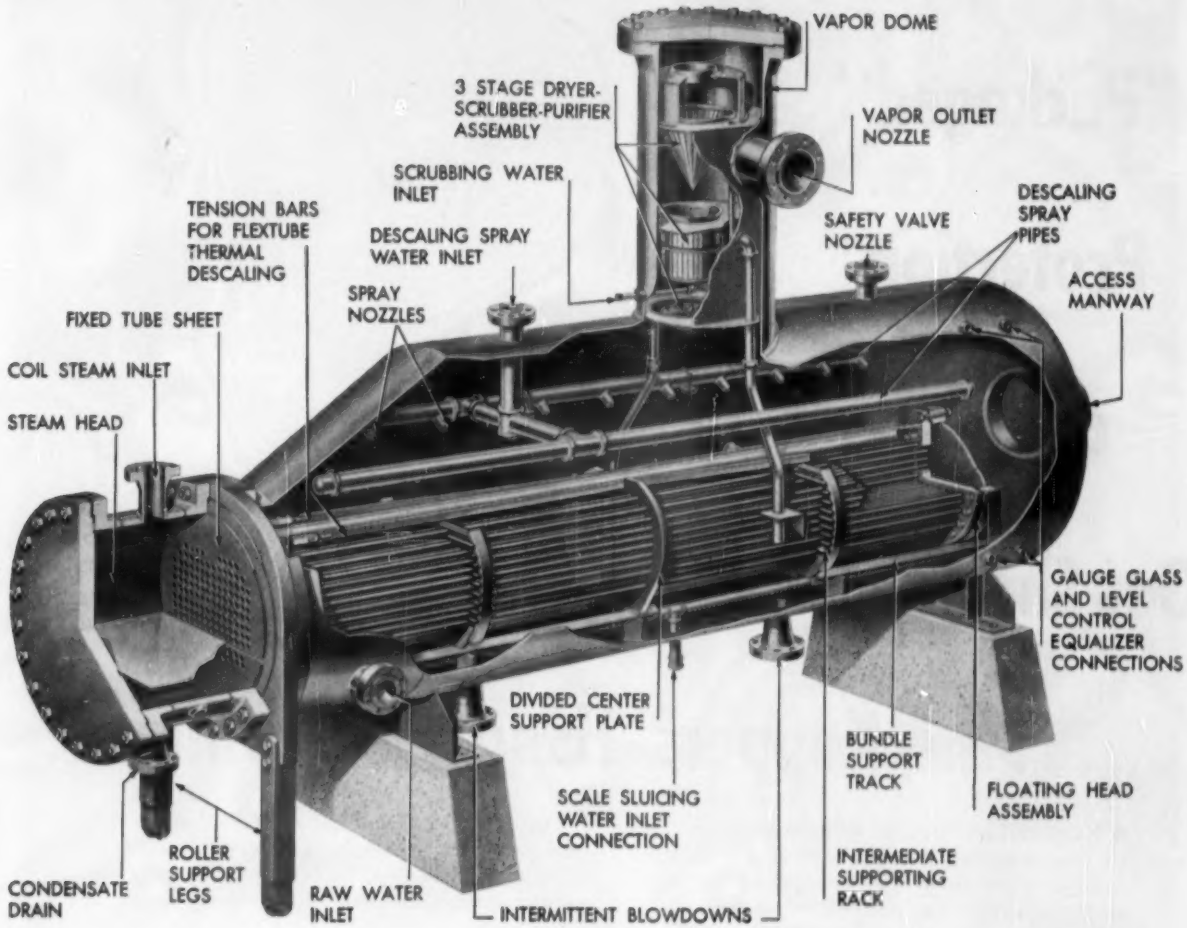
# THIS IS THE IMPROVED

# for efficient production of pure make-up water

This latest Alco Evaporator design is an example of high-standard Alco Engineering constantly striving for the improvement of heat-transfer equipment for modern steam power plants. The design features of Alco Evaporators add up to a compact, rugged, efficient unit that assures full capacity output of make-up water with less than one part per million dissolved solids.

ALCO EVAPORATORS are built to strict ASME code and custom engineered to meet your individual installation and performance requirements. Write or call your nearest ALCO Products representative and ask him to give you the details. Find out in terms of your own specific needs how ALCO EVAPORATORS are more efficient and give you greater value for your equipment dollar.

# ALCO EVAPORATOR . . .

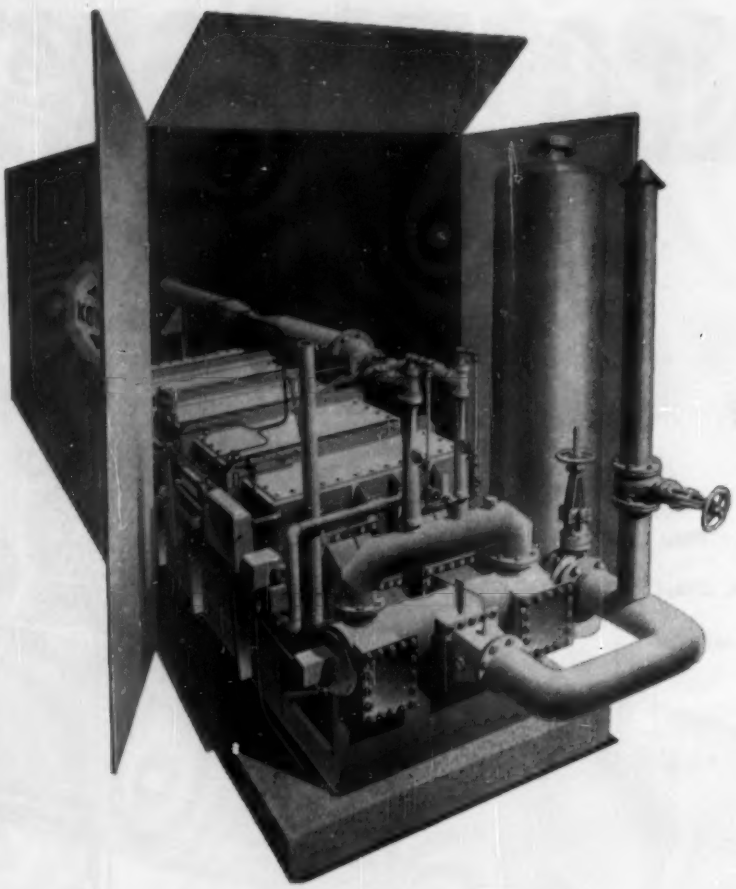



# ALCO

## PRODUCTS

**AMERICAN LOCOMOTIVE COMPANY**

# "Packaged" Protection against Gas Shortages



# . . . the Koppers-Hasche Reformer

**A KOPPERS-HASCHE REFORMER** produces low-cost gas that is interchangeable with most natural or manufactured gases. It is, therefore, ideal insurance against gas-supply emergencies.

If there is any interruption in the supply of natural gas, a Koppers-Hasche Reformer can "carry on" until normal service is resumed. This stand-by service is valuable to industries that utilize natural gas, because it prevents costly interruptions in the manufacturing processes.

The Koppers-Hasche Reformer is available in standardized "package" units. Through standardization of design, prefabrication of parts, and shop assembly, the Kopper-Hasche Reformer can be installed in your plant at remarkably low cost.

Operating cost is low, too. Units are almost entirely automatic in operation, requiring a minimum of operating labor and supervision. There are few moving parts, thus reducing maintenance.

**For full details . . .** send for this booklet describing the Reformer, its operation and its adaptability. Just write to:

KOPPERS®

**KOPPERS COMPANY, INC.**

**Engineering and Construction Division**
**Chemical and Gas Dept.**
**Pittsburgh 19, Pennsylvania**

*HIGH-POTENTIAL TESTS HELP PROVE . . .*

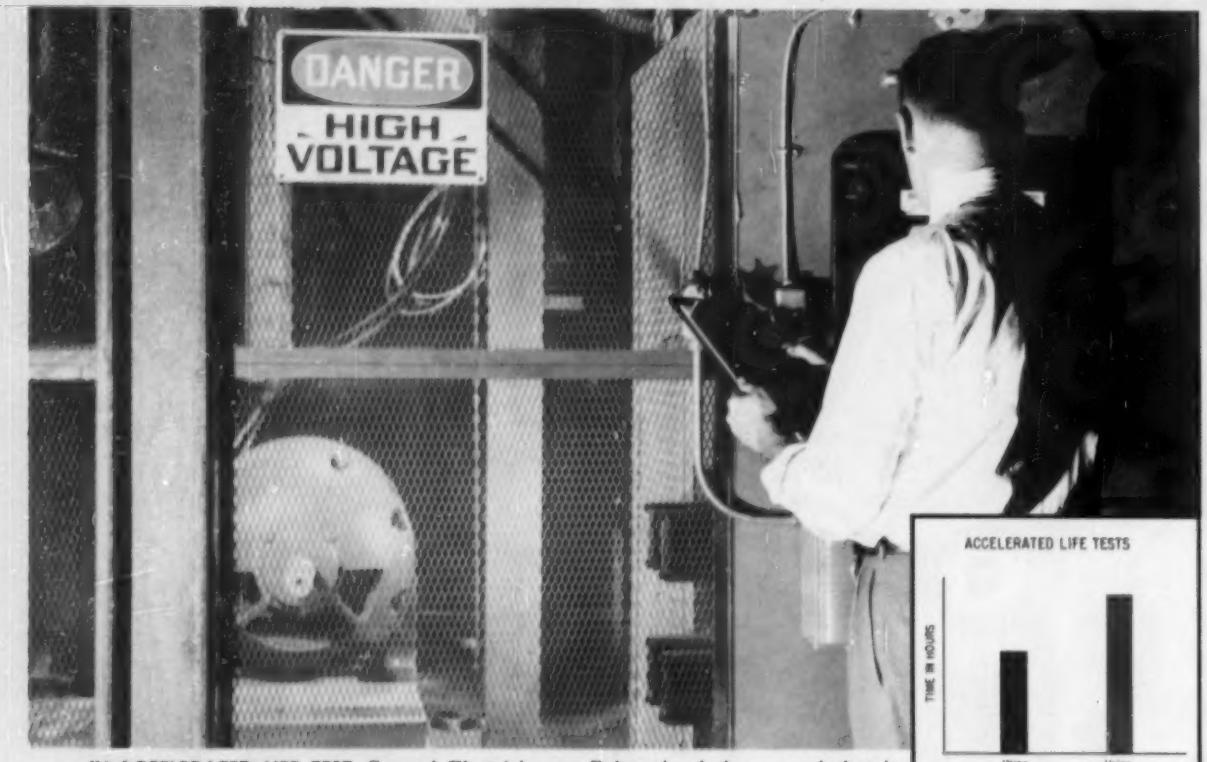
# NEW INSULATION MAKES G-E MOTORS LAST 50% LONGER

*See Details Inside*

## 50% LONGER MOTOR LIFE

*An engineering achieven*

# General E
# That is



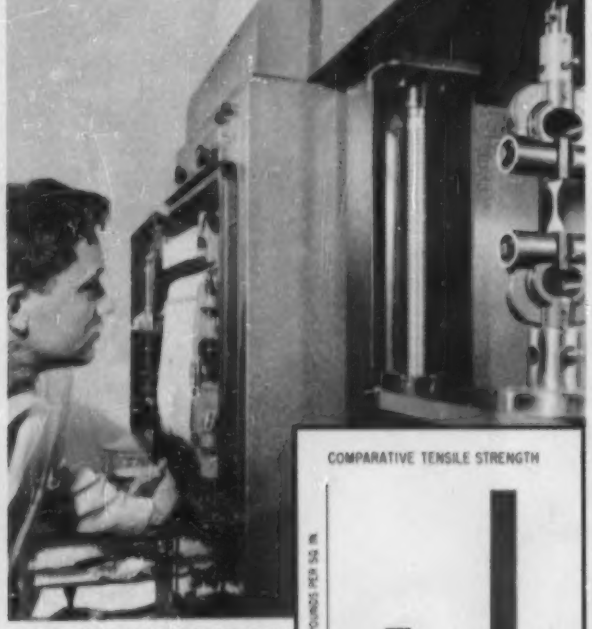

**IN ACCELERATED LIFE TEST,** General Electric's new Polyex insulation proved that it could take extreme heat aging and mechanical stress. Here is a summary of test results...

### REVOLUTIONARY *POLYEX* IN
### OF THE AMAZING PROPERTIES

General Electric has developed a complete new Class A insulation for form-wound co which lasts 50% longer than other insulations use today. Its greater ability to withstand phy ical and thermal stresses provides an add margin of protection that will mean tremendo savings to you because of reduced motor failu and maintenance costs.

**POLYEX INSULATION** is a balanced system polyester films and fibres, together with n hydrocarbon resins. Materials in new Poly insulation have high dielectric and physi

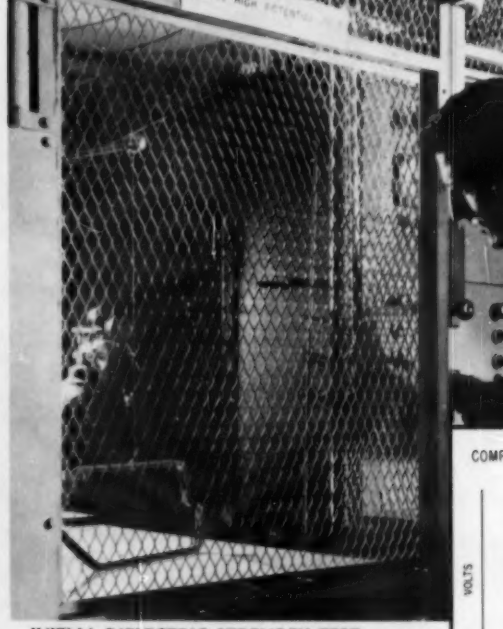
## 7 TIMES GREATER PHYSICAL STRENGTH




**TENSILE STRENGTH** of new insulation offers a greater protection against physical stress.

**CUT-THROUGH STRENGTH,** seven times greater than conventional insulation, is another reason for long life.

## 50% MORE DIELECTR




**INITIAL DIELECTRIC STRENGTH TEST** measures insulation's ability to withstand operating and starting voltages, and the protection offered against insulation failure.

***vement of vital importance to users of motors with form-wound coils . . .***

# Electric Develops New Insulation for Motors
# 7 Times Tougher, Adds 50% to Motor Life

**Y INSULATION TAKES FULL ADVANTAGE**
**ES OF NEW POLYESTER FILMS AND FIBRES**

pletely
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Polyex
hysical

strength. For the first time, the cotton and paper-based tapes and sheets in conventional insulations have been eliminated.

**RESULTS OF EXHAUSTIVE TESTS** on new Polyex insulation are summarized on these pages. Insulation qualities like these offer you tremendous savings in motor maintenance and a greater degree of service continuity than ever before possible.

**GENERAL ELECTRIC RESEARCH** for better insulation is a continuing program. Polyex insulation is the latest result of that program. Three years of intensive development and testing of materials and manufacturing techniques culminated in the most significant advance in large motor insulation in 45 years.

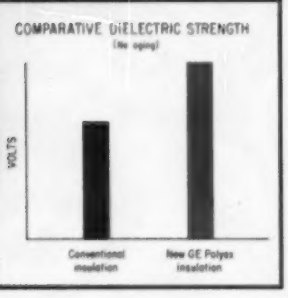
**POLYEX INSULATION IS NOW AVAILABLE** in many ratings of General Electric induction motors in the range of 100 to 3000 HP—and at no extra cost.

**YOUR G-E SALES REPRESENTATIVE** has complete information. Contact him at your nearby General Electric Apparatus Sales Office. *General Electric Company, Schenectady 5, New York.*

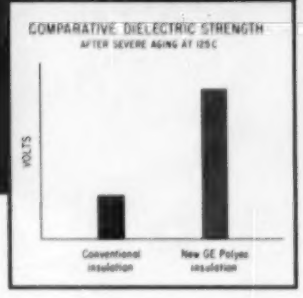
*Progress Is Our Most Important Product*

**GENERAL ELECTRIC**

**CTRIC STRENGTH, EVEN AFTER HEAT AGING**

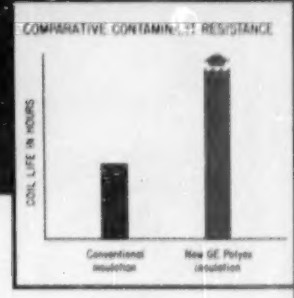


**BAKED FOR THOUSANDS OF HOURS** at 125°C, Polyex insulation was tested again. It proved that it retains its higher physical and dielectric properties after heat aging.



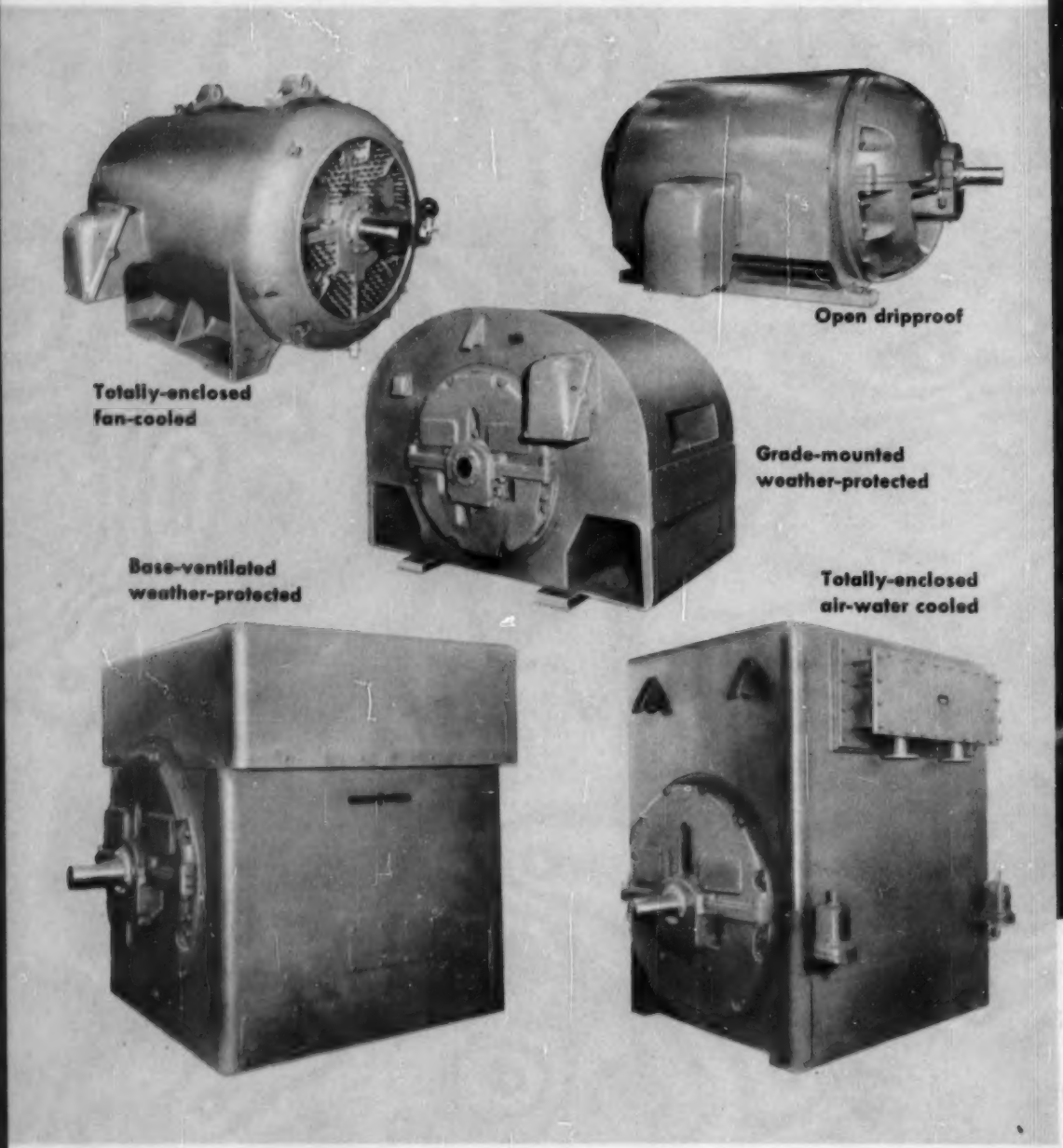

**CONTAMINANT RESISTANCE DOUBLED**

**IN SALT SOLUTION,** insulation's ability to resist contaminants was tested. Polyex-insulated coils were still operating long after conventional coils had failed.



# NOW AVAILABLE IN MANY RATINGS OF THESE G-E INDUCTION MOTORS

(Approximately 100 to 3000 hp)




*Progress Is Our Most Important Product*

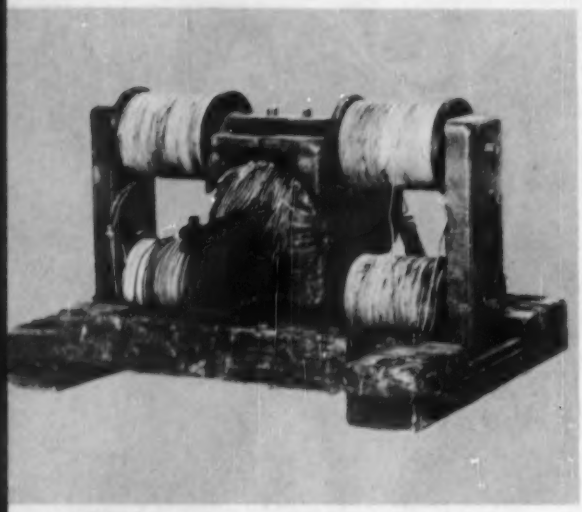
GENERAL ELECTRIC

***HIGH-POTENTIAL TESTS HELP PROVE . . .***

# NEW INSULATION MAKES G-E MOTORS LAST 50% LONGER

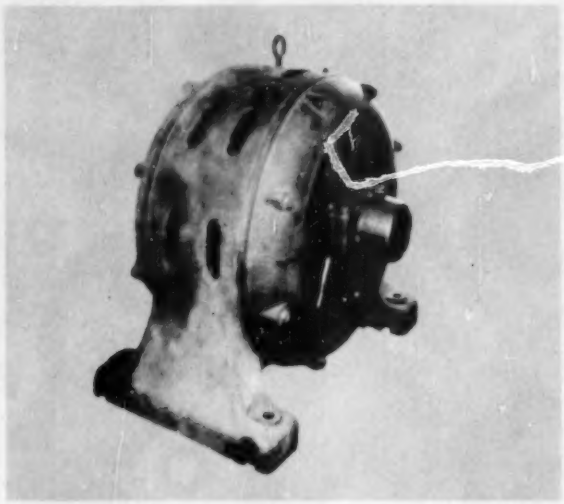
***See Details Inside***

# THE THIRD MAJOR STEP IN THE EVOLUTION OF FORM-WOUND MOTOR INSULATION SYSTEMS



**1878—FORM 1 INSULATION SYSTEM**

Air was the insulator in early motor coils. Cotton was wrapped around the coils, but served only as a spacer to provide an air gap. The cotton wrapping itself was worthless as an insulator.

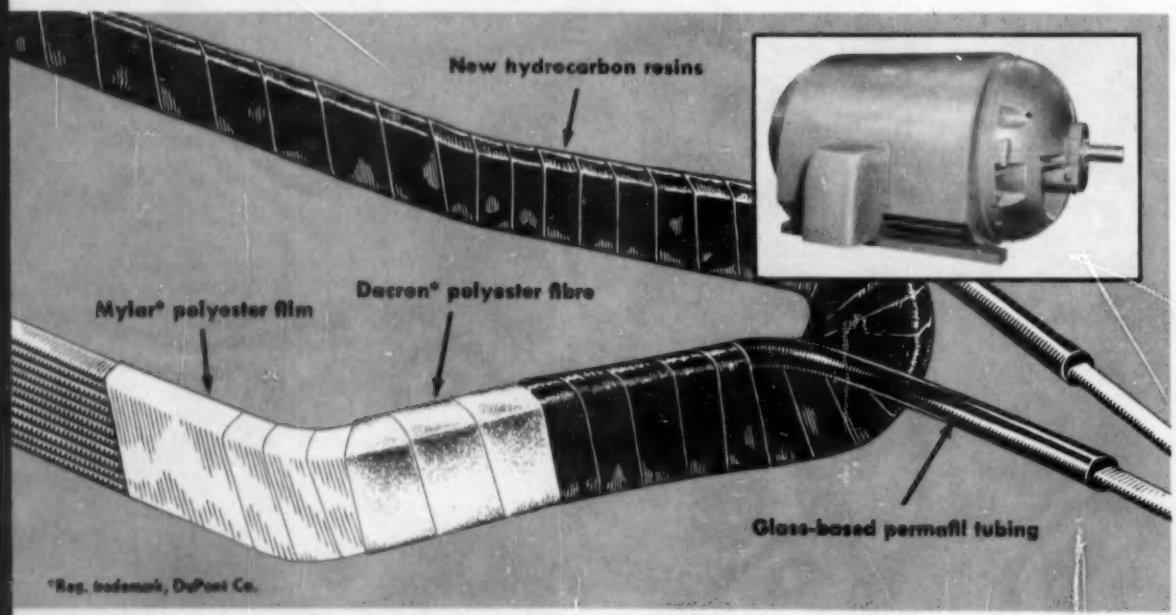


**1910—FORM 2 INSULATION SYSTEMS ESTABLISHED**

Linseed oil was added to cotton to provide insulating qualities. Since then, varnish and other insulating materials have replaced oil, but until now the basic concept has remained the same.

**1954—G.E. INTRODUCES FIRST FORM 3 INSULATION SYSTEM**

New G-E Polyex insulation becomes the first Form 3 insulation system. Made of polyester films and fibres, Polyex is the first insulation in which the materials have natural insulating qualities of their own.

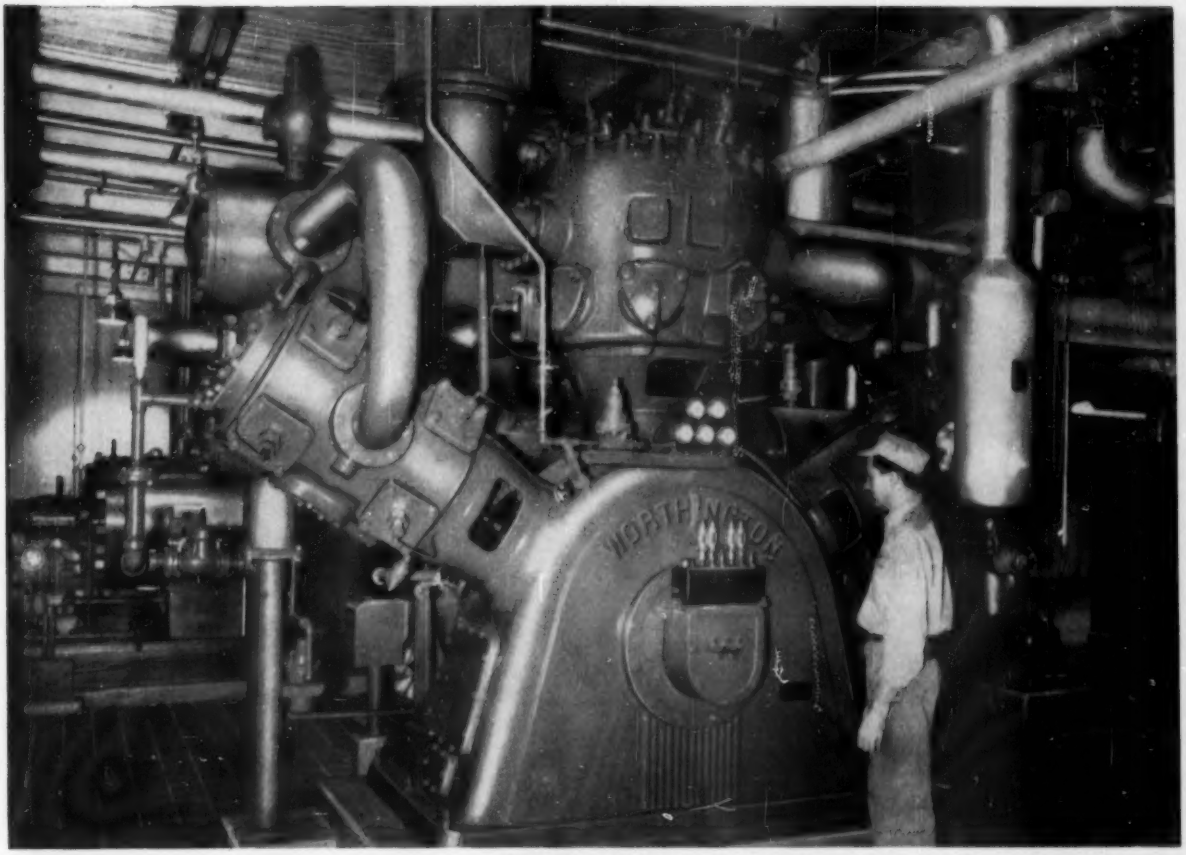



*Progress Is Our Most Important Product*

GENERAL ELECTRIC

830-14

Want to keep this information? Tear along perforated edge.




**PENNSYLVANIA POWER COMPANY** gets air for soot blowing from two Worthington DYC-3 air compressors at their New Castle Power Plant.

# Which is better for soot blowing — steam or air?

If we asked that question 20 years ago, the answer would be steam. But today you'd be right if you said "compressed air."

Key to the success of compressed air in soot blowing was the development of simple, automatic controls. Not only can you pre-select an operation sequence for efficient cleaning, but you're sure that the cleaning operation will be complete — and carried on only at the most efficient pressure.

Here are more reasons for using air for soot blowing:

1. Lower-cost, low-pressure, low-temperature piping — with no piping insulation required.
2. Savings on feedwater make-up.
3. Reduced blower maintenance.

For a *dependable* supply of air for soot blowing, more and more power plants — both industrial and municipal — are specifying Worthington compressors. They're equipped with the exclusive Feather* Valve — the lightest, tightest, most efficient valve made. They're designed to give more air — at less cost.

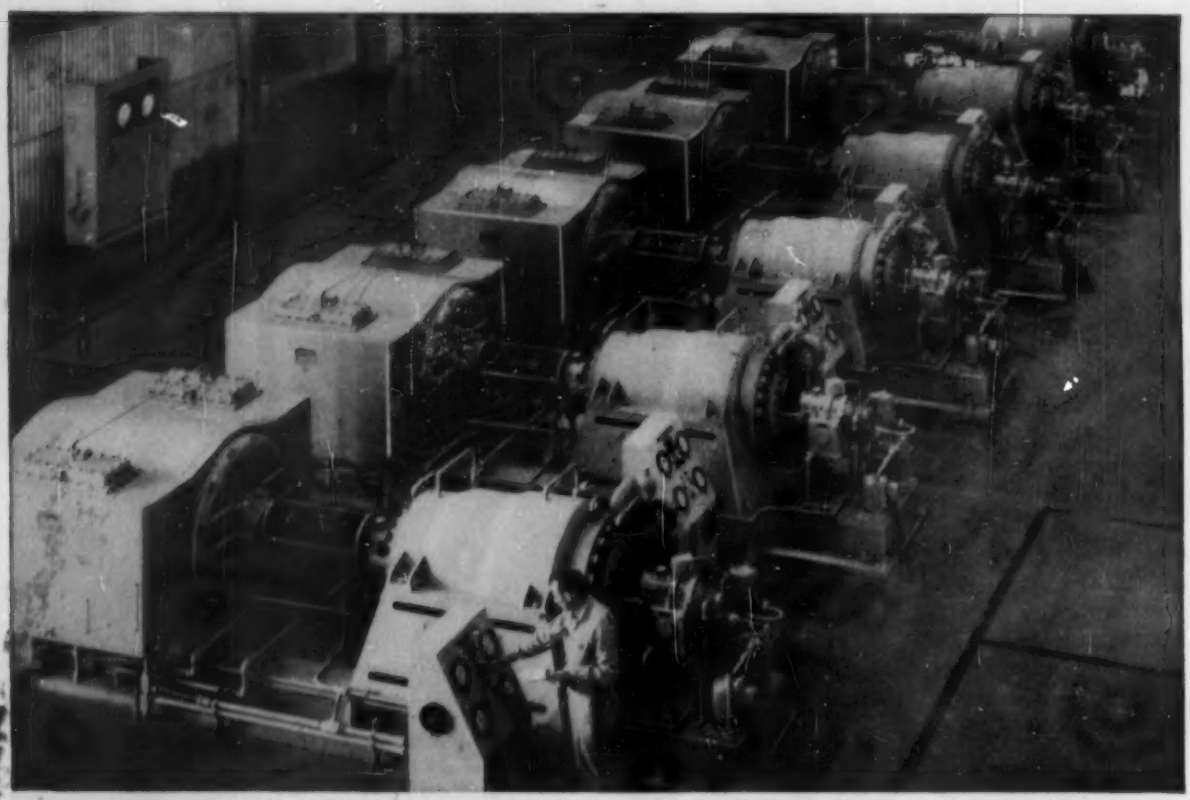
Read our Bulletin L600-B14 — "Worthington Compressors for Soot Blowing". Write for it to Worthington Corporation, Water-Cooled Compressor Division, Harrison, N.J.

*Reg. U.S. Pat. Off. K.4.6

**WORTHINGTON**

**Only Worthington Compressors give you Feather Valve Performance**

**V-Types • Balanced Angle • Horizontal • Portable • Radial • Gas Engine Compressors**



**SIX WORTHINGTON HIGH-PRESSURE BOILER FEED PUMPS** on the job at the Contra Costa Steam Plant of the Pacific Gas and Electric Company. Each pump delivers 500,000# per hour at a discharge pressure of 1,800 psig.

# What should you look for in a high-pressure* boiler feed pump?

We think we're qualified to answer that. Back in 1923 we built our first high-pressure centrifugal boiler feed pump, and we've had a lot of experience making them since.

Here are some of the features you should look for:

**All pressure joints** should be *metal-to-metal ring type joints*, universally accepted as the proper construction for high-pressure service.

**Inner assembly** should be firmly anchored to the casing barrel at the inboard end, but *free to expand* under temperature changes at the outboard end without destroying perfect centering of running joints and bearing support.

**Internal joints** constructed so that hydraulic pressure acts to seal joints, rather than open them. Only in pumps of this design can the tightness of the internal joints be hydraulically tested during the process of assembly.

**Pump casing** made of forged steel, the same material that is selected for all high-pressure fittings and valves.

**Centerline support** of casing should allow for temperature changes with minimum distortion.

**"Volute-passage" diffuser** to eliminate narrow diffuser passages and a multitude of diffuser vanes.

All of these, by the way, are standard on Worthington high-pressure boiler feed pumps. And our customers are pretty happy about it, too.

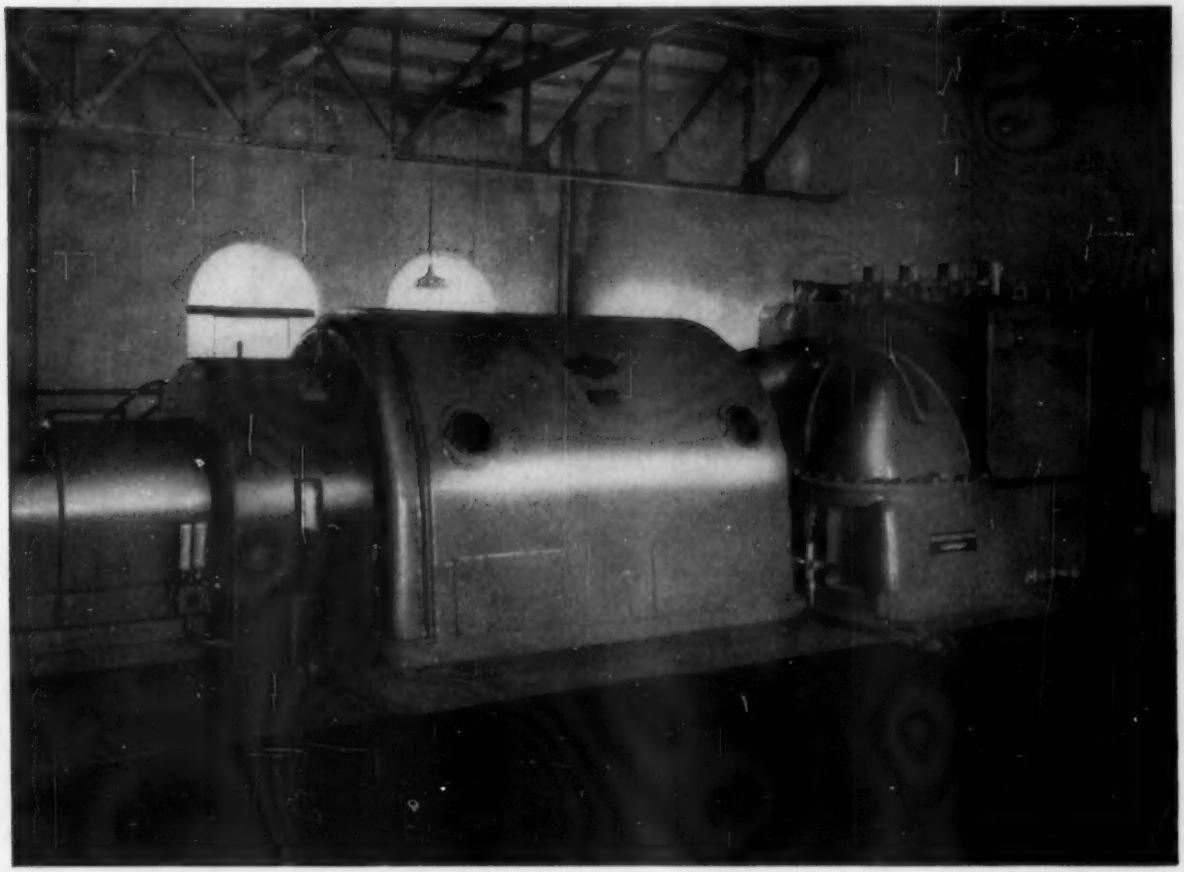
Ask for our Bulletin W319B-1C. Write Worthington Corporation, Centrifugal Pump Division, Harrison, New Jersey. *Over 1300 psi. C.3.12

**SEE the Worthington Corporation Exhibit in New York City. A lively, informative display of product developments for industry, business and the home. Park Avenue and 41st Street.**

**WORTHINGTON**

***The World's Broadest Line Assures You the Right Centrifugal Pump for Every Job***

**Boiler Feed Normal Service** • **Hotwell, Condensate, Chilled Water** • **Water Works, Circulation, Drainage, General** • **Boiler Feed High Pressure Service**



**NEWEST OF THREE WORTHINGTON POWER UNITS** installed in Detroit Lakes' Minn., municipal power plant is this 4000-kw extraction-condensing turbine-generator.

# Production up–fuel costs down

That, in brief, is the happy story of the municipal power plant at Detroit Lakes, Minnesota.

Here's what happened. For the past few years Detroit Lakes has been modernizing its power plant. This program, highlighted by the installation of Detroit Lakes' third Worthington turbine-generator, has reduced fuel costs by more than 23% — despite a steady increase in plant output.

Other Worthington equipment also contributed to this fine performance record. The Worthington condenser, steam jet air ejector, air compressor, and cooling water, condensate and feedwater pumps all played their part in keeping production up — and costs down.

It's clear that this Worthington equipment has paid off for Detroit Lakes. Not so evident is the secure feeling the Detroit Lakes people get from knowing that every Worthington unit is designed, assembled and tested as a complete unit *before* shipment.

This undivided responsibility can mean dollars saved for you, too. Get the whole story from your nearest Worthington district office. Or write to Worthington Corporation, Steam Turbine Division, Section T.4.6, Wellsville, N.Y.

T.4.6

**WORTHINGTON**

**STEAM TURBINES**

**Single and Multi-Stage Turbines • Turbine-Generators • Deaerators • Boiler Feed Pumps • Surface Condensers**

**A GREAT TEAM IN STEAM**

*Real* economy in condenser tubes is achieved when a sound balance is achieved between first cost, long-range operating efficiency and maintenance expense.

In applications where contaminated salt or fresh water and high velocities are encountered, Bridgeport Duronze IV (Alloy 53) Condenser Tubes meet these requirements. Although first cost is slightly more, the improved performance, better corrosion resistance and longer tube life, prove the *Real* economy of Bridgeport Duronze IV.

Bridgeport's Technical Service will be happy to tell you about the economies of Duronze IV, or recommend one of the many other Bridgeport Condenser Tube Alloys best suited for your particular application. Call your local Bridgeport office for immediate service.

Want to receive our monthly Copper Alloy Bulletin regularly? Ask us to add your name to our mailing list. The Bulletin contains news about the latest developments in the condenser tube field and useful design and maintenance helps.

**BRIDGEPORT BRASS COMPANY ♦ BRIDGEPORT, CONNECTICUT**

*Serving Industry with a Nationwide Network of Conveniently Located Sales Offices and Warehouses.*

Mills at Bridgeport, Conn., Indianapolis, Ind., and Adrian, Mich.

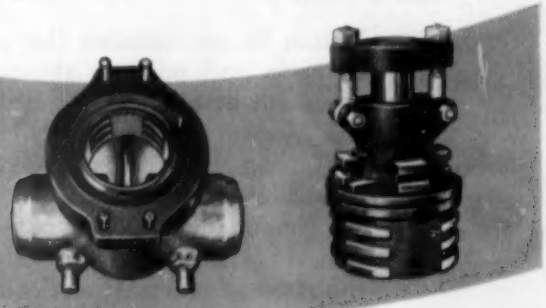
*In Canada:* Noranda Copper and Brass Limited, Montreal

# STOP VALVE LEAKAGE IN YOUR HIGH PRESSURE STEAM AND BOILER FEED LINES

## BREECH LOCK *Flexible* DISC VALVES

Lunkenheimer Breech Lock Valves are built to control steam and water at high pressures and temperatures with absolute safety and freedom from leakage. The patented disc is flexible and resilient to assure tight seating and prevent sticking when in the closed position. The body and bonnet are locked together like the breech mechanism of a large gun. Internal pressure loads are carried by the inter-locking breech lugs, and the joint is made pressure tight by a seal weld. Gaskets, threaded rings and bolts are eliminated. The bonnet joint can be readily disassembled and reassembled.

WRITE FOR the address of your nearest Lunkenheimer representative, who will give you full details and make specific recommendations. The Lunkenheimer Co., Box 360A, Cincinnati 14, Ohio.



**BREECH LOCK**
**1500 LBS. S.P.**
**STEEL GATE**

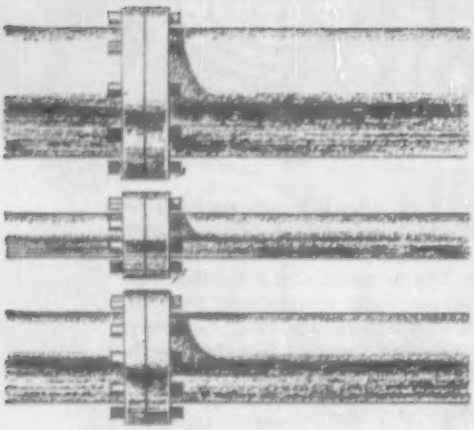
STEEL • IRON BRONZE

L 451-4

# LUNKENHEIMER

THE ONE *Great* NAME IN VALVES

# This REPUBLIC
## Combustion Control System



## AUTOMATICALLY SELECTS LOWEST COST COMBINATION OF THREE AVAILABLE FUELS

Three fuels — blast furnace gas, coke oven gas, and fuel oil — are burned by three 125,000 lb. per hr. steam generating boilers at a large midwestern steel plant.

In addition to maintaining the proper fuel-air ratio and holding steam pressure constant at all loads, a Republic Control System automatically makes fuel selections according to the amount of by-product blast furnace gas available. At times when this low cost gas is plentiful, it is used as the primary fuel. The other two fuels are used only for make-up when available blast furnace gas cannot meet all of the fuel demand. If the blast furnace gas pressure falls below a predetermined minimum, however, flow is automatically reduced and one of the other two fuels also burned.

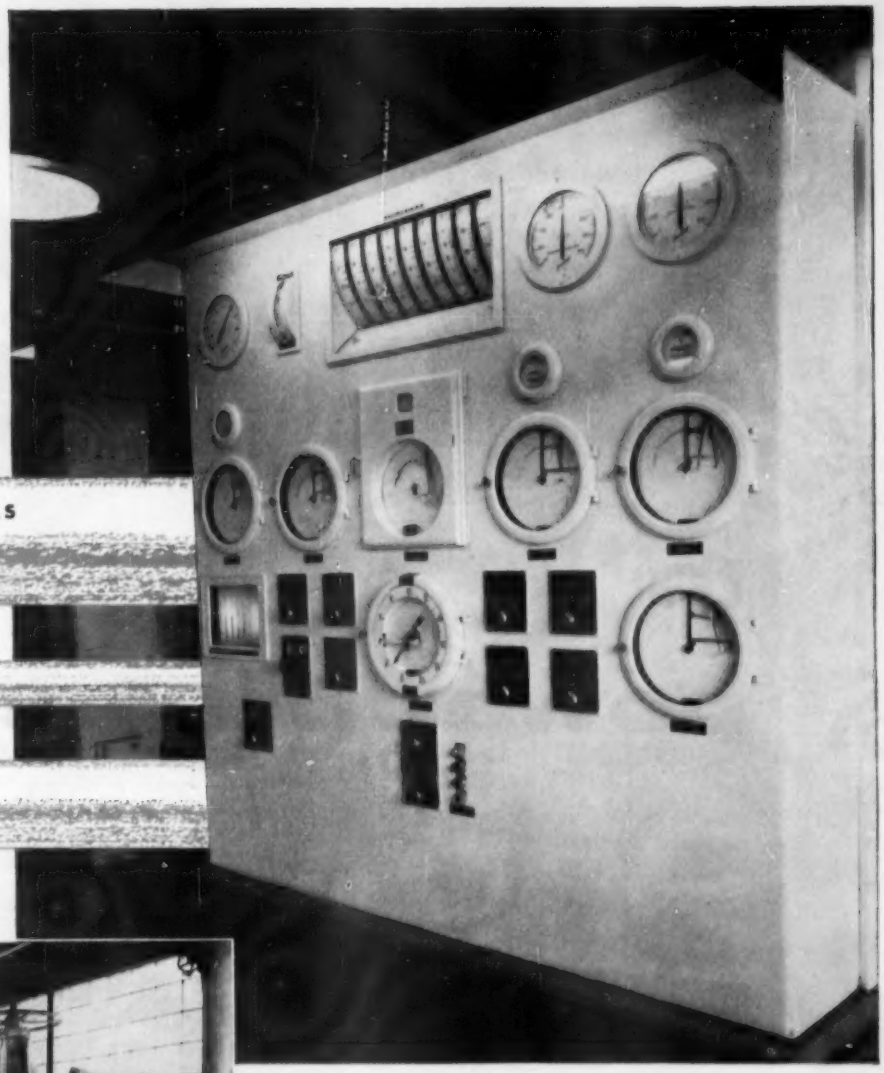
This dual purpose Combustion Control System cuts fuel costs two ways:

(1) Because of efficient combustion, less fuel is used for a given steam output.

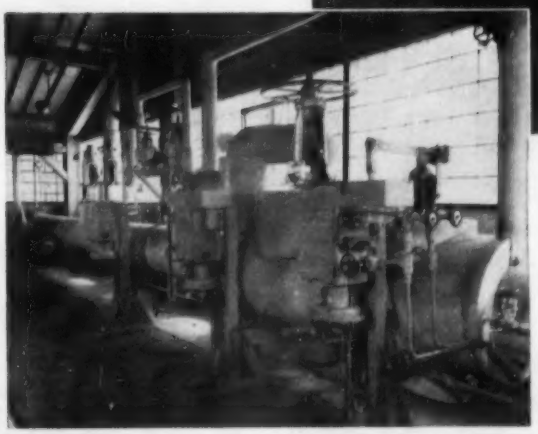
(2) As much lowest cost fuel is used as possible.

Control Systems such as this one further illustrate how Republic engineers can design combustion controls that make the most of fuels available. Very likely, Republic can show *you* ways to get more power at less cost — automatically.

**REPUBLIC FLOW METERS CO.**




Boiler panel at steel mill power plant includes sub-panels and instruments for multi-fuel firing system. The boiler draft and fuel selection may be controlled manually from this panel, if desired.



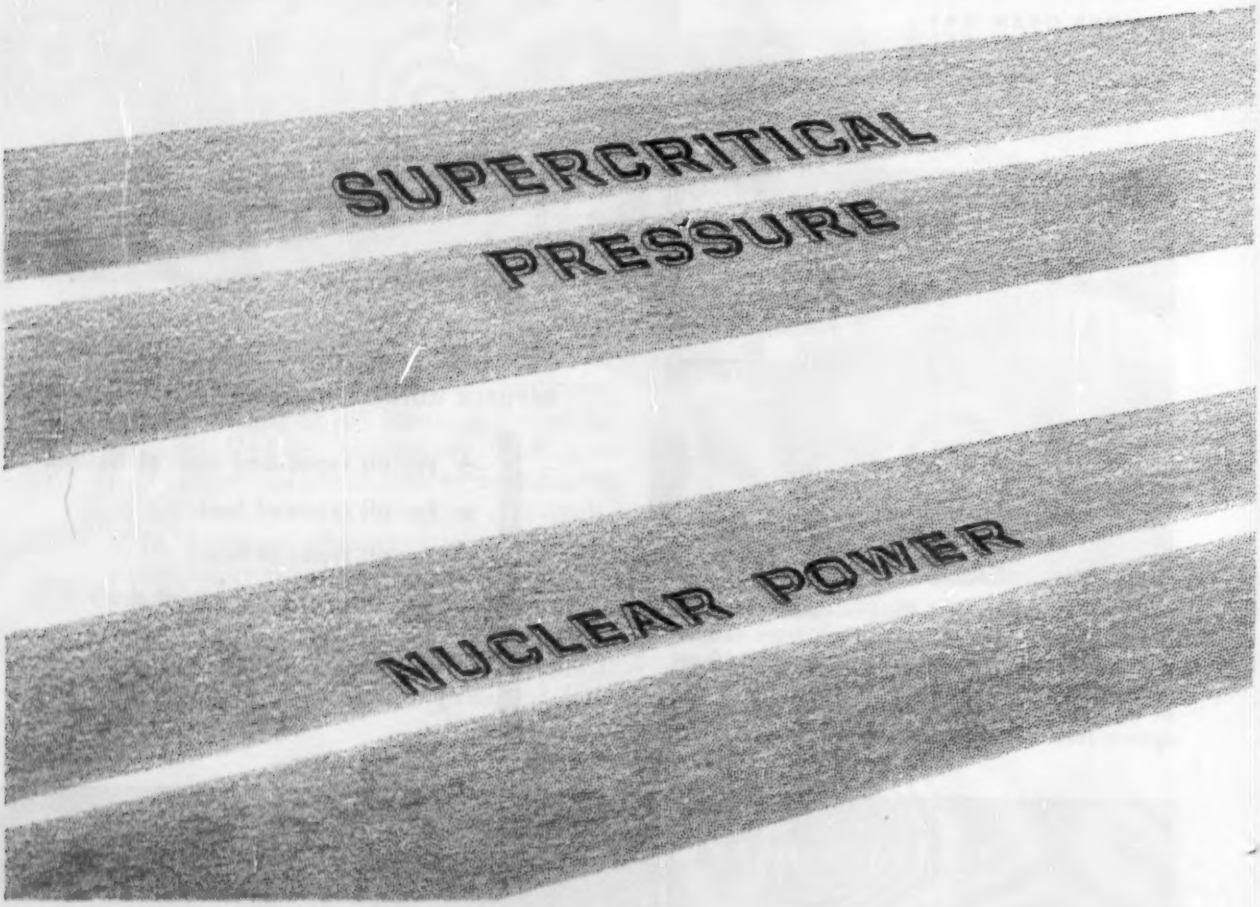
Pressure Reducing and Desuperheating Station furnished by Republic drops steam from 425 psi and 750°F. to 500°F. and 250 psi max.—180 psi min. High and low pressure safety regulators at the desuperheater station protect the boiler system from unusual steam demands.

**REPUBLIC AUTOMATIC COMBUSTION CONTROLS**

- ★ For all types and sizes of boilers
- ★ For all types of fuel
- ★ For all types of firing
- ★ For all arrangements of draft
- ★ For all load conditions

2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

# new HIGHWAYS to power progress



It seems especially fitting that the two most notable power projects of our times should have been undertaken in 1954 – the year of Light's Diamond Jubilee. These projects are:

**World's most efficient power plant.** To be built by Philadelphia Electric Company, this new station will have a turbine-generator unit rated at 275,000 kw – the largest single-shaft unit ever ordered – which will receive steam at 5,000 psi throttle pressure and 1200 F (initial operation – 1150 F). The expected heat rate at initial conditions is 8400 Btu per kwhr. The steam generating unit will be furnished by Combustion Engineering and will generate steam at the highest pressure and temperature of any existing or projected power plant in the world. It will be a C-E Sulzer Monotube Steam Generator of the super-pressure "once-through" type, using forced circulation. Maximum design conditions are 6,000 psi and 1200 F, with double reheat, both stages at 1050 F.

**America's first nuclear power station.** To be built and operated by the Duquesne Light Company, this will be the first U. S. commercial-size nuclear power station. The heart of this plant – the giant pressure vessel that will house the reactor – will be manufactured by Combustion Engineering for the Westinghouse Electric Corporation, which has the A.E.C. contract to build the reactor. This vessel, one of the heaviest-walled vessels ever made, will contain an atomic core of more than 10 tons of enriched uranium. While substantial effects of nuclear power on our economy may not be felt for the next decade or two, Combustion through its Nuclear Power Division, is carrying on extensive development in this field, looking toward the day when power from the atom will be commonplace rather than revolutionary.

• • •

Combustion Engineering, associated with many of the installations that have made power history during the past three decades, takes special pride in the important part it will have in these two most notable projects of the new power era.

C-E

# COMBUSTION ENGINEERING

**Combustion Engineering Building • 200 Madison Avenue, New York 16, N. Y.**

B-785A

BOILERS, FUEL BURNING & RELATED EQUIPMENT; PULVERIZERS, AIR SEPARATORS & FLASH DRYING SYSTEMS; PRESSURE VESSELS; AUTOMATIC WATER HEATERS, SOIL PIPE

# EFFICIENT PLANNING

# Starts with RIC·WIL

● Early planning with a RIC-WIL field representative on central heating or air conditioning systems will mean less work later on. Custom engineering and prefabrication of RIC-WIL units offer quick, efficient installation. RIC-WIL's engineering service with forty-five years experience in the Insulated Piping Field is available for *early* planning and consultation.

Write or phone your nearest representative or send for the illustrated RIC-WIL catalog.

*Quality Piping Systems of the . . .*
*. . . Highest Thermal Efficiency*

**RIC·WIL INCORPORATED**

**PREFABRICATED INSULATED PIPING SYSTEMS**

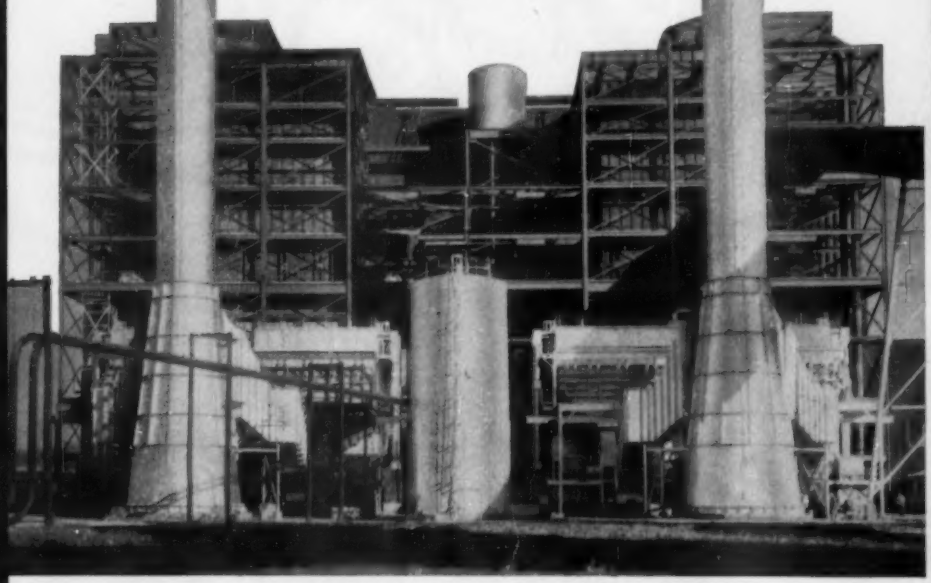
**BARBERTON, OHIO**

# What are they using at Meramec?

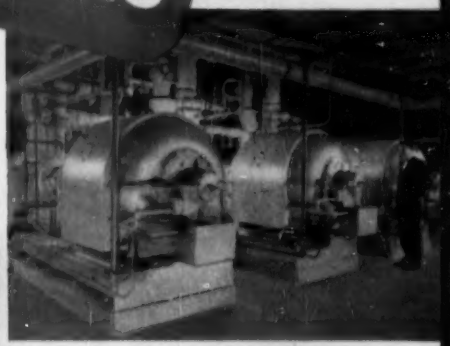
Another utility uses Allis-Chalmers motors. At Union Electric Company's new Meramec plant, all motors for all auxiliaries were furnished by Allis-Chalmers.

Allis-Chalmers builds a complete line of integral horsepower motors for power plant service. Your A-C representative will be glad to help you select the best motors to meet your needs.

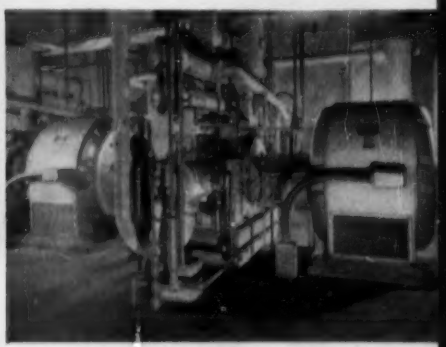
ALLIS-CHALMERS
Auxiliary-Drive
MOTORS



Built in the modern semi-outdoor style, Union Electric Company's Meramec station has two units with a total installed capacity of 250,000 kw.



Three of six 1500-hp, 3580-rpm, 4000-volt Allis-Chalmers two-pole motors driving boiler feed pumps.

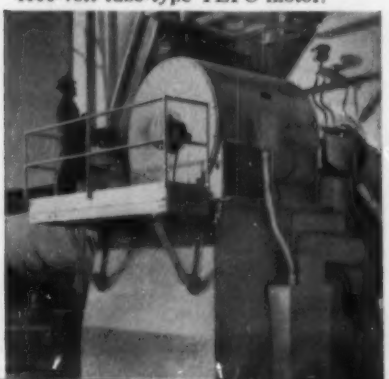


Two of three 300-hp, 353-rpm, 4000-volt Allis-Chalmers squirrel-cage motors driving soot blower air compressors.

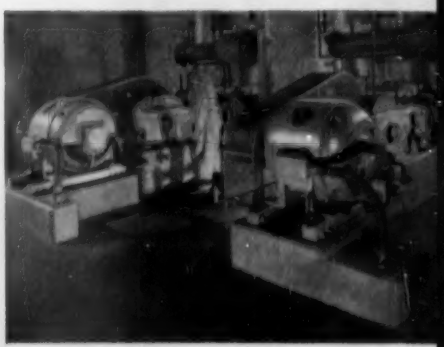
**ALLIS-CHALMERS**

Milwaukee 1, Wisconsin

Each induced draft fan is powered by an Allis-Chalmers 1000-hp, 710-rpm, 4000-volt tube-type TEFC motor.



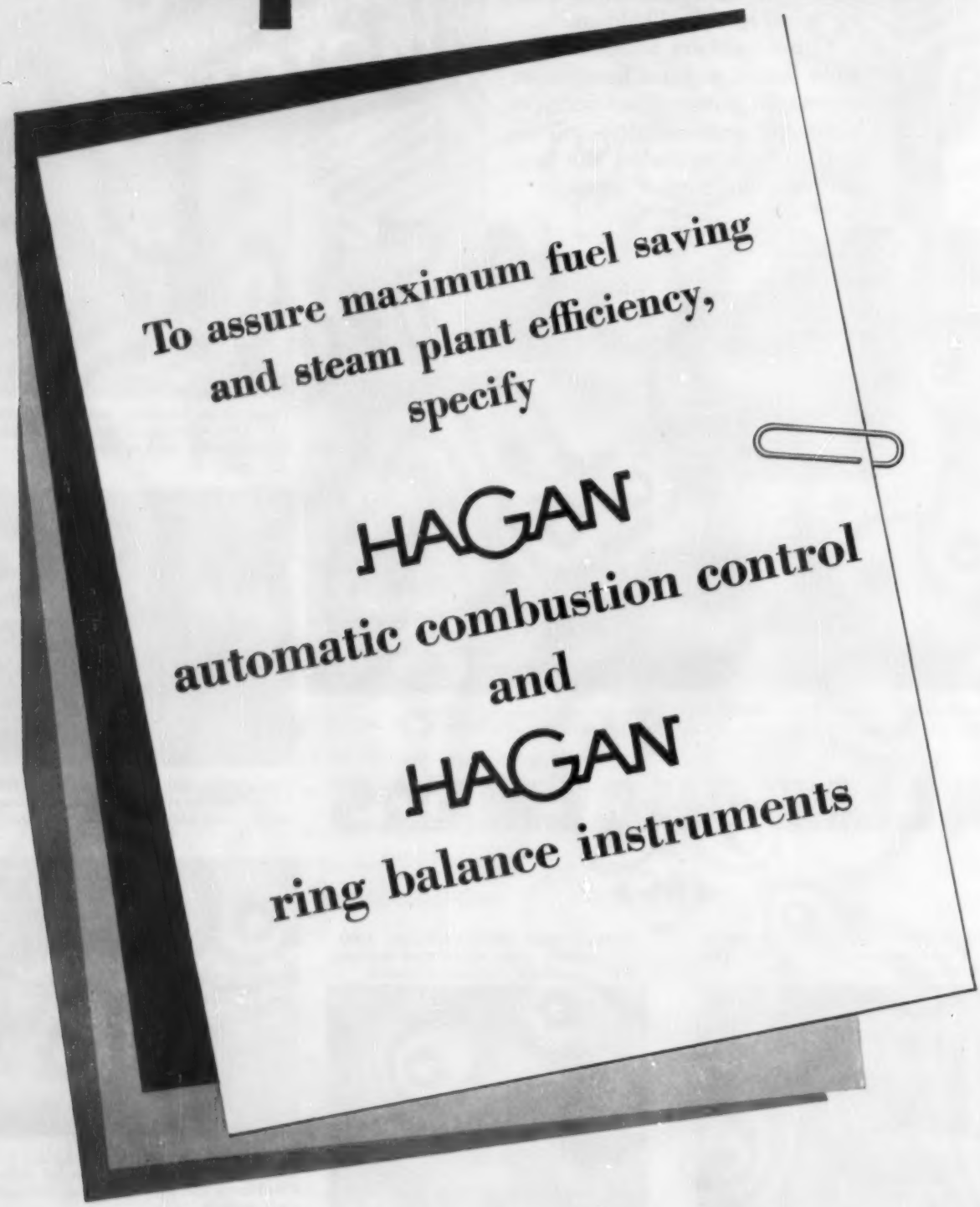
Four of these 500-hp, 425-rpm, 4000-volt vertical pipe-ventilated motors drive condenser circulating pumps.



These compressors provide air for service lines . . . are driven by Allis-Chalmers 100-hp, 1170-rpm, 440-volt cage motors.

A-4526

# Specification



# for Saving Fuel

The fuel saved by the average system of Hagan Automatic Combustion Control pays back the initial investment within the first year of operation. Comparable savings continue as long as the boilers last. This is a clear profit, amounting to many times the price of the Hagan Automatic Combustion Control.

The indications and records of Hagan Ring Balance Instruments provide the operators with the performance picture necessary for maintaining top efficiencies.

The design and construction of all components stress durability, accuracy and versatility. There is a system of Hagan Automatic Combustion Control and Ring Balance Instrumentation for every boiler plant, with any number or size of boilers, operating at any steam pressure and temperature, and burning all types of fuels, singly or in multiple.

**Hagan methods and Hagan equipment are also operating successfully in such applications as:**

- Boiler drum water level control, with automatic set point adjustments available.
- Superheated steam temperature control.
- Steam pressure reduction and spillover control.
- Draft or pressure control over a continuous range from fractions of an inch water column to 5000 psig.
- Feedwater heater pressure or temperature control.
- Recording, indicating and integrating flows of water, steam, liquid and gaseous fuels.
- Simultaneous records of two separate flows, measured in a single meter housing.
- Pressure and temperature compensated records of steam and gas flows.
- Density compensated records of boiler drum water level.
- Pneumatic and electric signal transmission for remote recording.

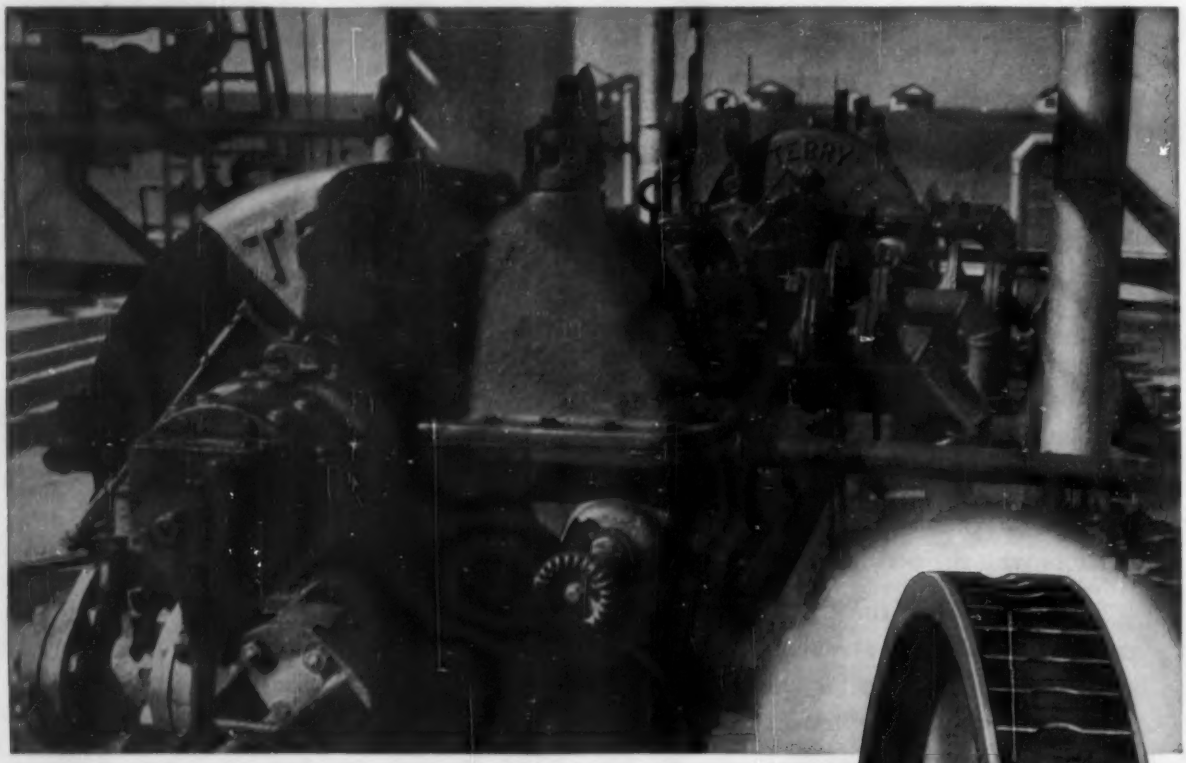
**For modernization or extension of existing installations, or for new construction, our engineers will be glad to suggest the best system to fulfill your requirements.**

## HAGAN CORPORATION

HAGAN HALL BUROMIN CALGON

**HAGAN BUILDING • PITTSBURGH 30, PENNSYLVANIA**

**Boiler Combustion Control Systems • Ring Balance Flow and Pressure Instruments • Metallurgical Furnace Control Systems • Control Systems for Automatic and Aeronautical Testing Facilities**



# Two Terry Turbines equipped with "trouble eliminators"

Because these turbines have solid wheels, they can take a lot of abuse, without complaint. Here's why:

1. The wheel has no separate parts to become loose or work out. It is a single forging, in which a series of semi-circular buckets is milled.

2. Blade wear is of little consequence because the power-producing action of the steam takes place on the curved surfaces at the back of the buckets. Wear does not materially affect horsepower or efficiency.

3. The blades cannot foul. There is a one inch clearance on either side of the wheel and, in addition, the blades are double rim protected. There is no need for close axial blade clearance, because the steam enters the buckets in a direction at right angles to the shaft.

For complete details of these *work horses of industry*, send for a copy of bulletin S-116. No cost or obligation.

**THE TERRY STEAM TURBINE CO.**

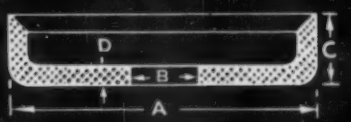
TERRY SQUARE, HARTFORD 1, CONN.

TERRY

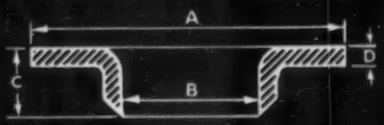
TT-1199

# MOLDED CUPS, FLANGES, "U" PACKINGS

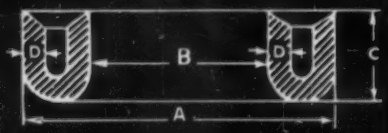
***from accurately dimensioned molds to assure BETTER SERVICE!***




"CUP" Shaped




"FLANGE" Type




Round Bottom (R) "U"

Flat Bottom (F) "U"

"U" Shaped

OUR OWN SPECIAL COMPOUNDS AND DESIGNS

Anchor molded cups, flanges and "U" packings are formed in accurately dimensioned molds, made with special compounds ranging from natural rubber to the most appropriate synthetic rubber, all assuring long life and low friction.

Molded parts are used on a variety of equipment, packing against oil, solvents, air, water, gasoline.

Style 11 is made from strong cotton duck frictioned with an oil and solvent resisting compound. Recommended for high pressure oil, water, gasoline, etc., on presses, pumps, clutches, welding equipment, lifts, jacks, etc. Also on air where rapidity of stroke will require packing with a low coefficient of friction.

Style 43 Flexible type is a softer grade — better where flexibility is essential. Recommended for equipment requiring a very sensitive packing to insure a positive seal on air, oil, water, etc. . . . also recommended for equipment with mechanical irregularities such as slightly worn, scored, and remachined cylinder rods.

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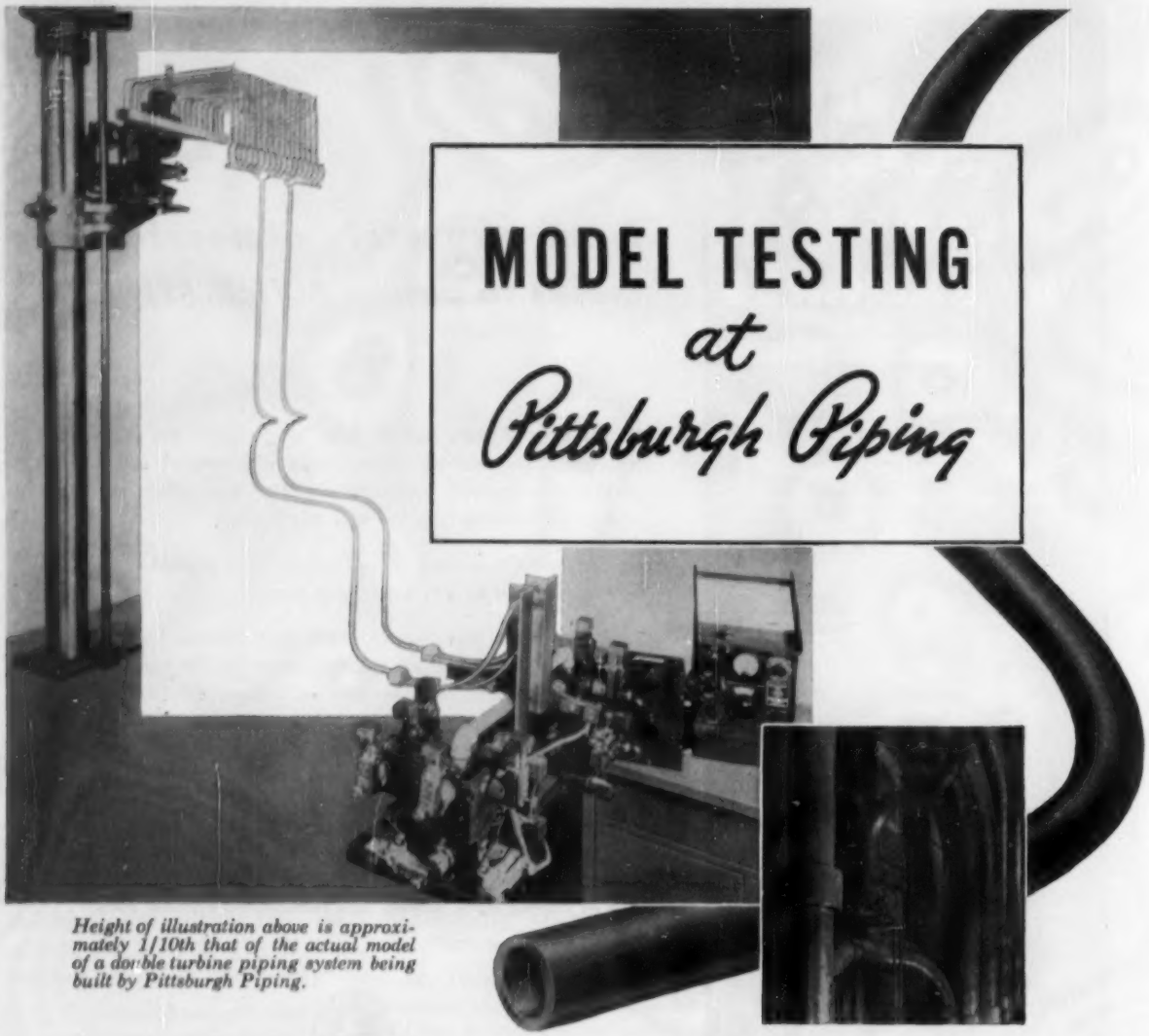

# MODEL TESTING *at* Pittsburgh Piping

*Height of illustration above is approximately 1/10th that of the actual model of a double turbine piping system being built by Pittsburgh Piping.*

## *Accurately Predicts Physical Reactions of* HIGH PRESSURE, HIGH TEMPERATURE PIPING

Model testing makes practical the planning of high pressure, high temperature piping systems with advance knowledge of end reactions, stresses, and deflections encountered in actual operation.

The model illustrated exactly duplicates from an engineering standpoint — in miniature — a double turbine piping installation being built by P.P.& E. for one of America's foremost utilities. Highly specialized testing apparatus accurately measures and directly indicates physical reactions at all points of this model under simulated operating temperature and pressure loads. These measurements are projected to give precise information on the full size system.

On complex piping layouts model testing at Pittsburgh Piping is the only practical means to obtain a complete analysis. It eliminates the need for dependence on theoretical approximations, and minimizes the possibility of mathematical error. Data obtained from model testing enables construction of a full size system which is free from excessive stresses, reactions and movements which could damage joints, anchors and equipment connected to the pipe line.

*Promoting Progress* IN POWER AND PROCESS PIPING . . .

| | | | |
|---|---|---|---|
| Atlanta | Whitehead Building | Houston | Heights State Bank Bldg. |
| Boston | 10 High Street | Los Angeles | 3830 N. Alexandria Ave. |
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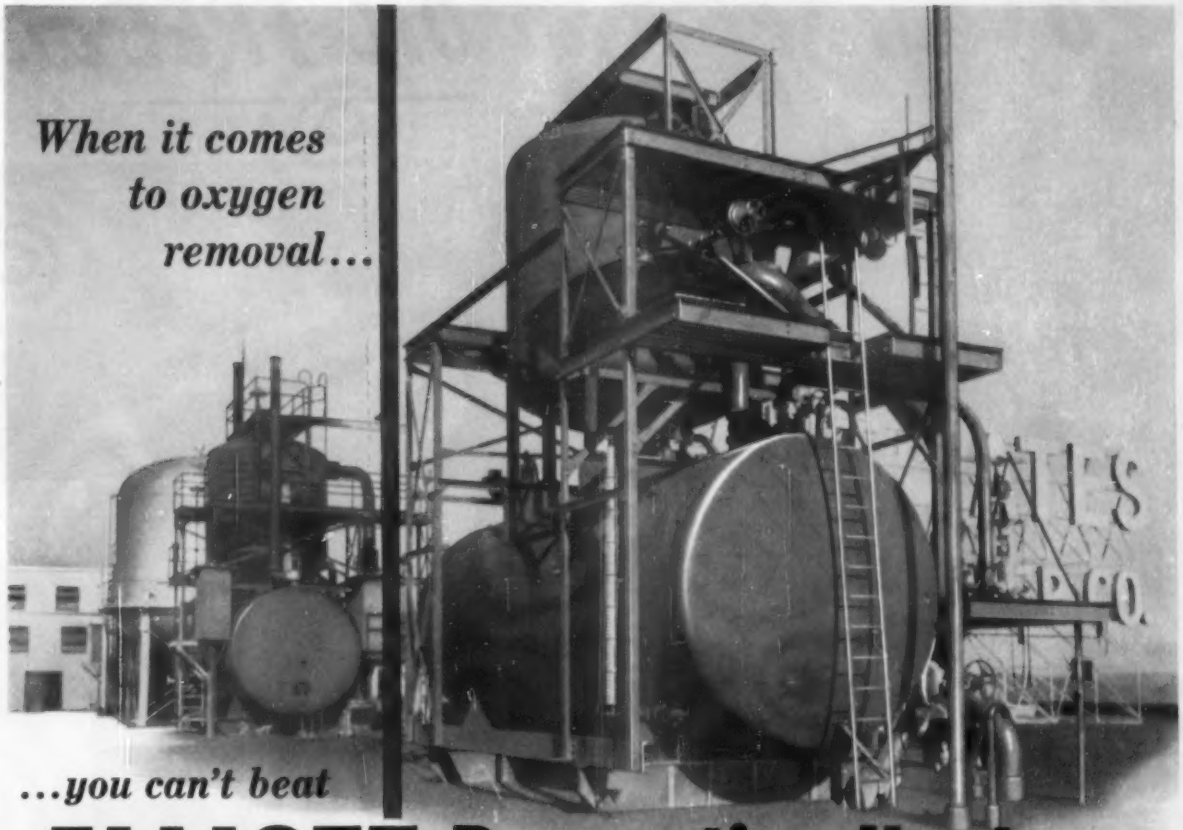
| Cleveland | Public Square Building | New York | Woolworth Building |

**Pittsburgh Piping AND EQUIPMENT COMPANY**

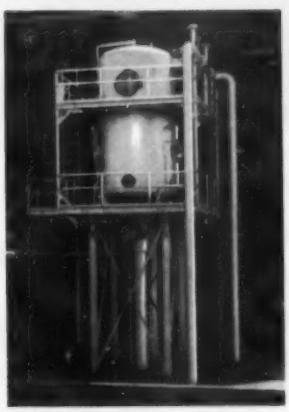
10 Forty-Third Street—Pittsburgh, Penna. PP-8



*When it comes to oxygen removal...*

*...you can't beat*

# ELLIOTT Deaerating Heaters



Elliott deaerating heaters are available in sizes from the smallest up to units with a capacity of 2,500,000 lb per hr. You'll find them serving boiler plants all over the country.

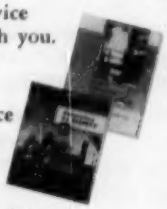
You invest in a deaerating heater to rid your feedwater of dissolved oxygen that, otherwise, would cause serious corrosion damage to your water and steam handling system and equipment.

Elliott deaerating heaters remove oxygen so completely that precision methods of testing consistently fail to show even traces of this corrosive gas remaining in the effluent. That's the *ultimate in deaerator performance.*

And you can be sure of this highly efficient performance when you invest in Elliott deaerating feedwater heaters because every installation starts with a careful study of the particular requirements, space and other conditions, and each unit is tailored to fit the specific requirements.

You can be sure, also, of the *last word in deaerating equipment* because Elliott pioneered deaeration and continues to lead the way in deaeration research and development.

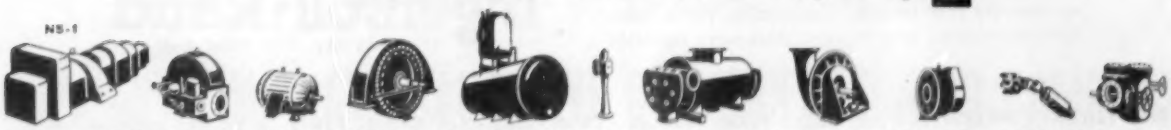
There's a fully qualified and experienced Elliott field service engineer near you, ready to call and talk deaeration with you. Write or wire Elliott Company, Deaerator and Heater Department, Jeannette, Pa.



***Write for these Bulletins*** – Bulletin N-18 covers the science of deaeration in detail. Bulletin N-19 shows how Elliott deaerating feedwater heaters satisfy every requirement.

**ELLIOTT Company**

NS-1



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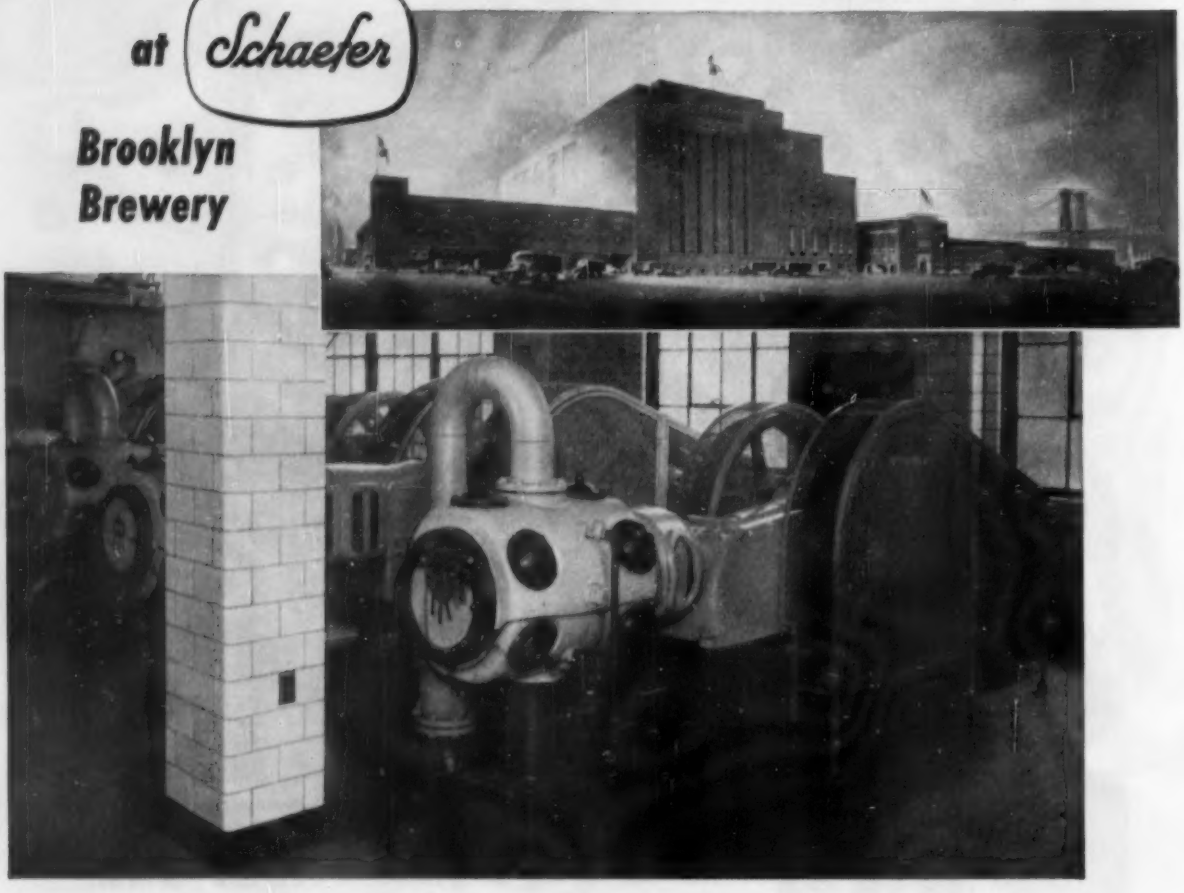
# 20 years of clean OIL-FREE air

at Schaefer Brooklyn Brewery



## Ingersoll-Rand Class ES Compressors with NL (non-lubricated) cylinders provide all plant and process air at one of America's largest and finest breweries

It takes a lot of air to operate a big, modern brewery — air for instrumentation, weighing, conveying, bottle capping, plant maintenance and movement of beer in preliminary processing. And any air that comes in contact with the beer or its ingredients must be *absolutely free of oil.*

The non-lubricated compressor was pioneered and developed by Ingersoll-Rand Company and it was here at Schaefer's, more than 20 years ago, that one of the first of such units was installed. Self-lubricated dry carbon rings eliminate the need for any oil in the cylinder or packing, keeping the air entirely free from contamination. Three more ES compressors with NL cylinders were installed later, and now all four of them are in daily service, as shown in the photo above at the Brooklyn plant of America's oldest lager brewers.

Wherever oil-free compressed air is needed, it pays to specify Ingersoll-Rand NL cylinders. Write or phone for complete details.

Ingersoll-Rand
11 BROADWAY, NEW YORK 4, N. Y.

1-69

ROCK DRILLS · COMPRESSORS · AIR TOOLS · TURBO BLOWERS · CONDENSERS · CENTRIFUGAL PUMPS · OIL & GAS ENGINES

# here's how high temperature piping can flex its muscles

Each pipe hanger is scale tested to rigid tolerances by a skilled workman at the Navco plant. After final assembly and inspection, the hangers are carefully crated and readied for shipment.

## NAVCO *Counterpoise* Pipe Hangers

Since high temperature piping has no respect for equipment connections, the entire piping system must flex its muscles to absorb the strain of expansion and contraction. This prevents serious stresses that could endanger the installation.

And how does high temperature piping flex its muscles? With Navco's precision engineered Counterpoise Pipe Hanger—the hanger with a load-supporting effort that is of constant value throughout the range of travel. This permits weightless movement of the entire piping system.

To learn how power plants, oil refineries and chemical plants can have piping systems that flex their muscles, write today for Navco's 12-page Counterpoise hanger bulletin #153.

NAVCO

**NATIONAL VALVE & MANUFACTURING COMPANY**

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# Stability of Performance on the job

## CLARAGE
### TYPE NH, CLASS II-A
## FORCED DRAFT FANS

## dependable **BROAD** efficiency, rather than S^H^A^R^P peak efficiency

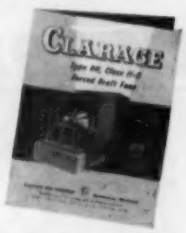
***No tendency*** toward unstable, unpredictable performance!

With the Clarage Type NH Fan you get efficiency where it counts: under actual operating conditions. Modern manufacturing techniques assure that each of these fans is accurately constructed to perform according to its rating and in line with its advanced design.

As fully described in Bulletin 802, Type NH, Class II-A forced draft fans are provided with independent bearing pedestals, split type housings, and non-overloading, backwardly inclined wheels (diameters 15" to 66").

Users agree that here is thoroughly dependable equipment fully answering within its performance range the requirements of modern power plants. For heavier duty forced draft service, Clarage fans are available in Classes III and IV construction.

Request Bulletin 802

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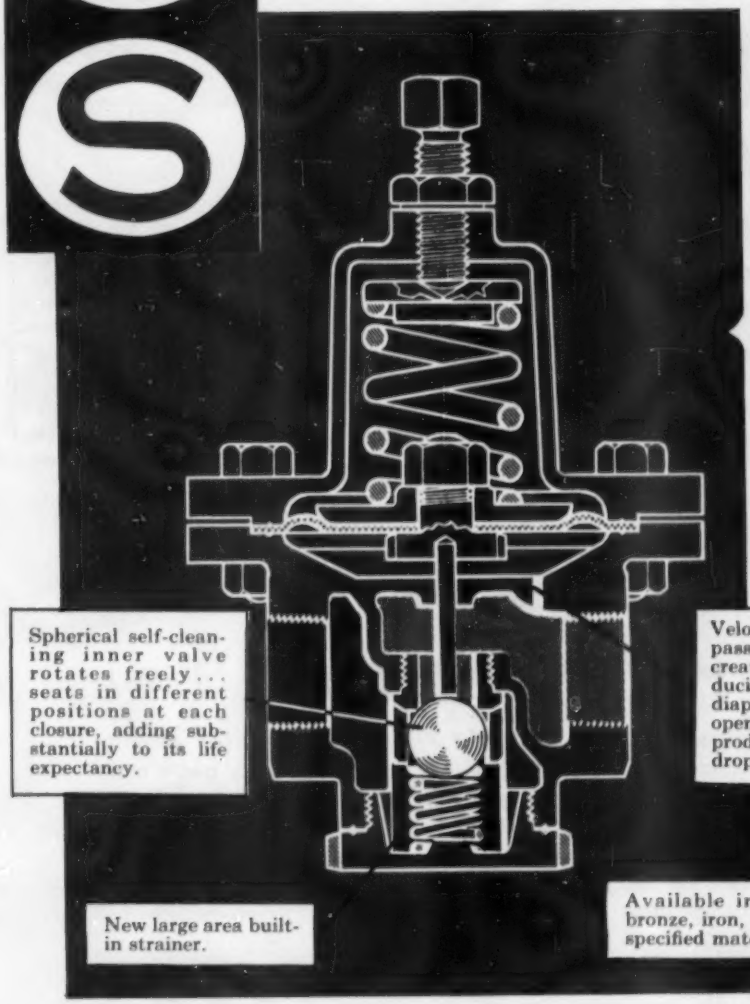
# THE LATEST CASH STANDARD VALVE

## TYPE 1260

*Direct Operated • Self Contained • Single Seat*
*Pressure Reducing and Regulating*


Spherical self-cleaning inner valve rotates freely... seats in different positions at each closure, adding substantially to its life expectancy.
Velocity of gas or liquid passing the body port creates suction, thus reducing pressure in lower diaphragm chamber and opening valve wider to produce lower pressure drop.
New large area built-in strainer.
Available in aluminum, bronze, iron, steel or other specified materials.

**WITH EXCLUSIVE DESIGN* for...**

- Extremely LOW PRESSURE DROP and LOCKUP
- MINIMUM SIZE and WEIGHT with MAXIMUM SENSITIVITY
- LOWER INITIAL COST
- LONGER LIFE
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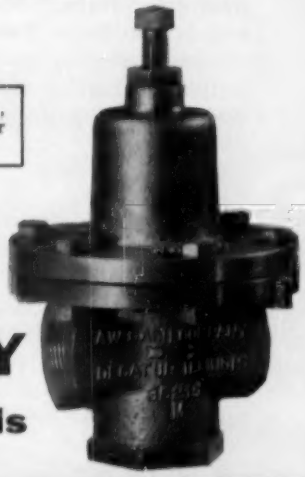
- 300 psi INLET PRESSURE ... 3 to 250 psi DELIVERED PRESSURE

*patent applied for



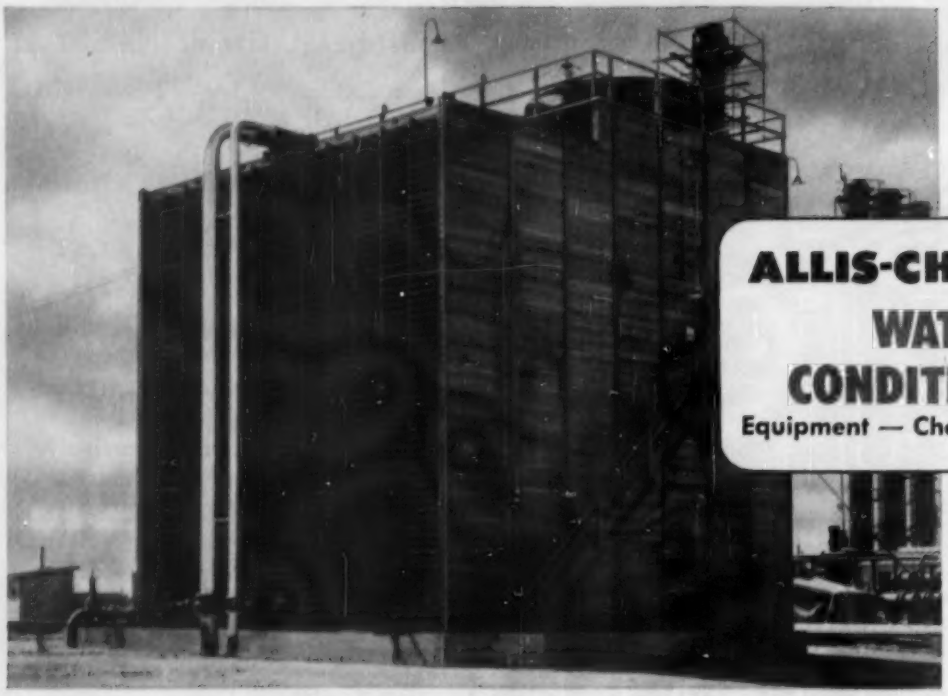
*WRITE TODAY FOR NEW BULLETIN*

## A. W. CASH COMPANY

**P. O. Box 551 • Decatur, Illinois**

PRESSURE, HYDRAULIC, TEMPERATURE, PROCESS AND COMBUSTION CONTROLS

# SOLVING WATER PROBLEMS in Cooling Towers




**Use of cooling towers** to save on water brings unusual problems. Some of these problems are corrosion, scaling, algae and slime, and deterioration of wood in the tower. Allis-Chalmers recently published an informational bulletin, Number 47A, which explains the causes of these problems and what can be done about them.

### Part of Practical Library

This bulletin is one of a series published by Allis-Chalmers to help you understand the causes and solutions of many water problems. It is the result of Allis-Chalmers experience solving water problems for every industry, in addition to solving problems involved in the company's own broad line of steam turbine and power plant equipment.

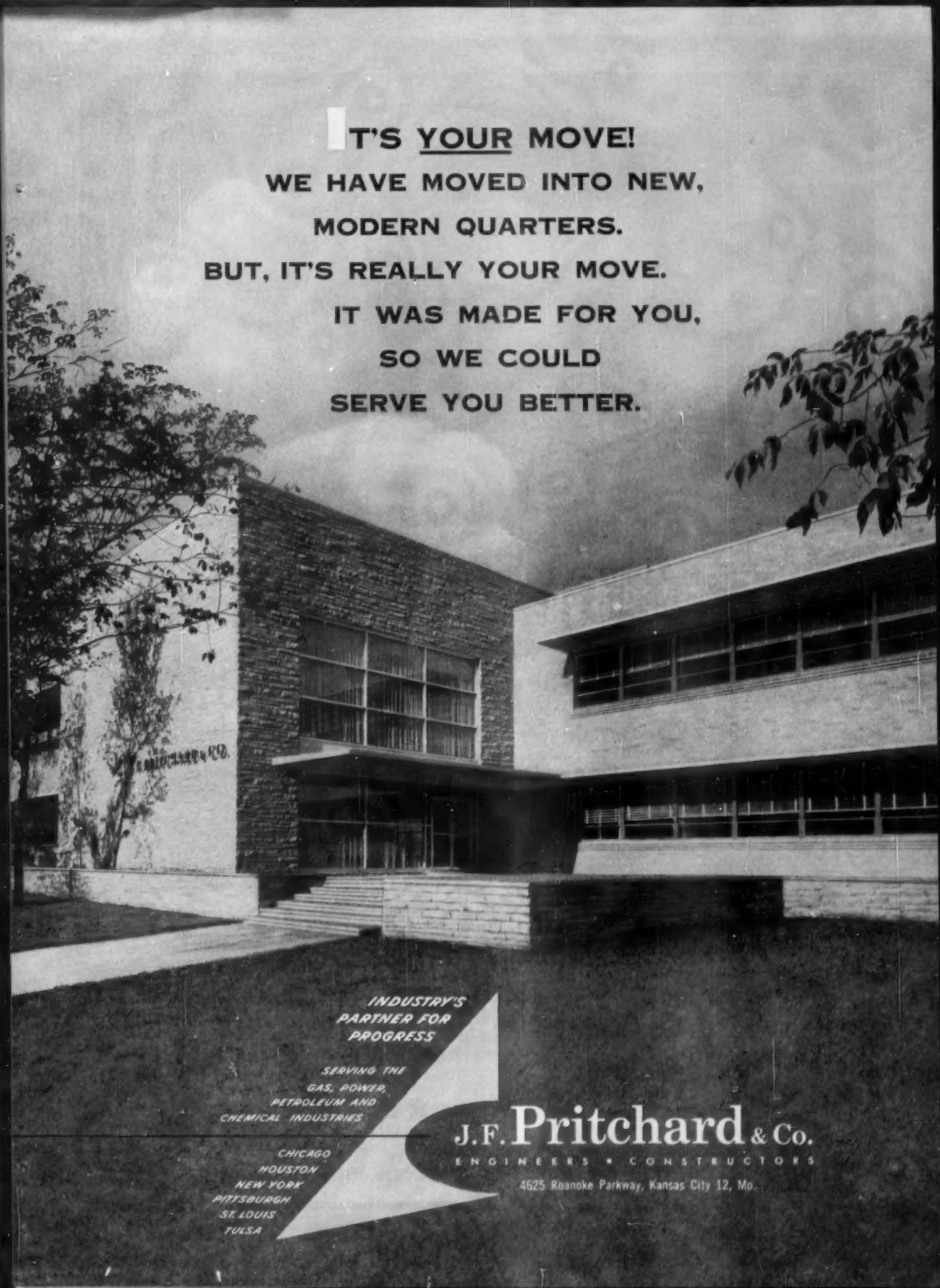
### Complete Water Conditioning Service

Allis-Chalmers offers complete water conditioning service. You can get analyses and reports on your problems. You can get chemicals needed in water treatment. And you can get the equipment needed for any system.

A-4316

***Get Information*** — For your copy of Bulletin 47A on water treatment for cooling towers, write Allis-Chalmers, Milwaukee 1, Wisconsin. Or better, call your nearby A-C district office to have an Allis-Chalmers water conditioning engineer consult with you on your problems.

**ALLIS-CHALMERS**


IT'S YOUR MOVE!
WE HAVE MOVED INTO NEW,
MODERN QUARTERS.
BUT, IT'S REALLY YOUR MOVE.
IT WAS MADE FOR YOU,
SO WE COULD
SERVE YOU BETTER.
INDUSTRY'S PARTNER FOR PROGRESS
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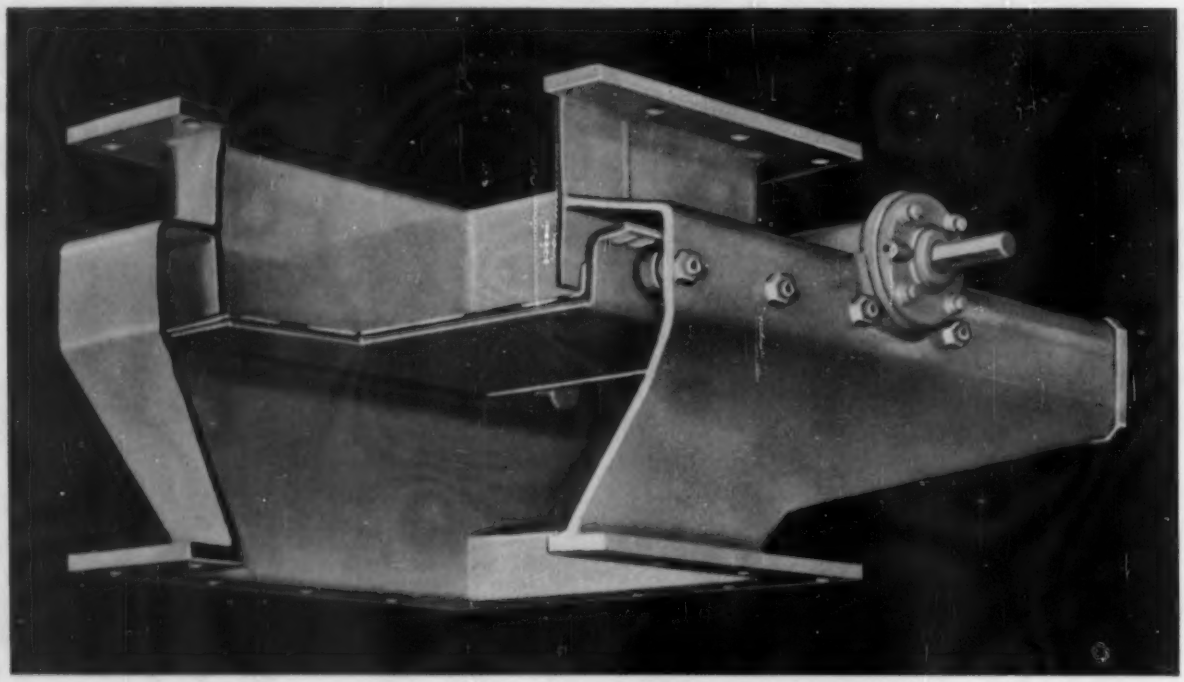

# Here's The Inside Story On The New
# S-E-CO. Coal Valve

Strip the ⅜" steel skin off our new coal valve and you'll quickly see why *you get more when you buy S-E-Co.*

First, notice the deep U-shaped gate which completely shields rollers, racks and pinions from coal flow. See how the gate provides lap closure on all four sides assuring positive cut-off. Also, note the stainless steel liner on top side of the gate to combat corrosion.

Carefully formed ladder racks, for their part, are self-cleaning having no root portion in which coal dust can build up and cause jamming. The multi-faced pinions, located above the racks, are also of self-cleaning design. Consequently, the gate moves smoothly with little effort, even after long periods of not being operated.

Notice the clean interior design. Slopes have been kept at a maximum with shoulders and projections eliminated. Even the poke hole covers fit flush with the inside of the valve body so that nothing interferes with flow of coal through the valve.

For a complete list of all the outstanding features of the new S-E-Co. Coal Valve together with installation photographs and dimensions, write for Bulletin No. 97.

**STOCK Equipment Company**

745-P, HANNA BLDG., CLEVELAND 15, OHIO

When you buy welding elbows . . .

# Why take less when you can get more?

## ADVANTAGES OF MIDWEST "LONG TANGENT" ELBOWS

- ★ They save pipe.
- ★ They often eliminate short nipples and their extra welds.
- ★ They save time and money in lining up and clamping pipe and fitting.
- ★ They make it easier to apply slip-on flanges.
- ★ They remove the circumferential weld from point of maximum stress and can be sleeved.
- ★ THEY COST NO MORE THAN OTHER ELBOWS.

As shown in the illustration above, Midwest "Long Tangent" welding Elbows have straight ends equal to ¼ of the nominal fitting diameter (a 12" elbow has tangents 3" long). For the reasons listed at the left, substantial savings are made on many piping systems by using Midwest "Long Tangent" Elbows. For more information about them, write for Catalog 54.

**MIDWEST PIPING COMPANY, INC.**

Main Office: 1450 South Second Street, St. Louis 4, Mo.

*Plants: St. Louis, Passaic, Los Angeles and Boston*

Sales Offices:
New York 7—50 Church St. • Chicago 3—79 West Monroe St.
Los Angeles 33—520 Anderson St. • Houston 2—1213 Capitol Ave.
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*STOCKING DISTRIBUTORS IN PRINCIPAL CITIES* 6722

MIDWEST WELDING FITTINGS IMPROVE PIPING DESIGN AND REDUCE COSTS

# One flow control does the work of nine

## Denison Multi-Range Flow Control infinitely adjustable for any delivery without changing spools

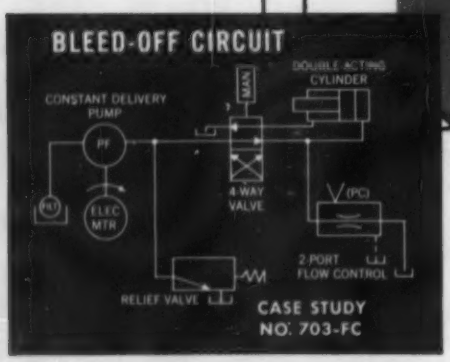
One dial now controls flow for as many as nine different ranges . . . assures accurate rate of flow . . . often eliminates need for a variable-volume pump.

With Denison Multi-Range Flow Control, there's no need to change valves or spools. If pump delivery is changed, simply turn the dial.

Available in ¼, ⅜ and ¾-inch port sizes. For any circuit to 3000 psi. Capacities to 28 gpm.

Subplate-mounted, Denison Multi-Range Flow Controls come in 2-port and 3-port types . . . with or without built-in check valves. The 3-port type meters flow to the work and diverts excess to tank.

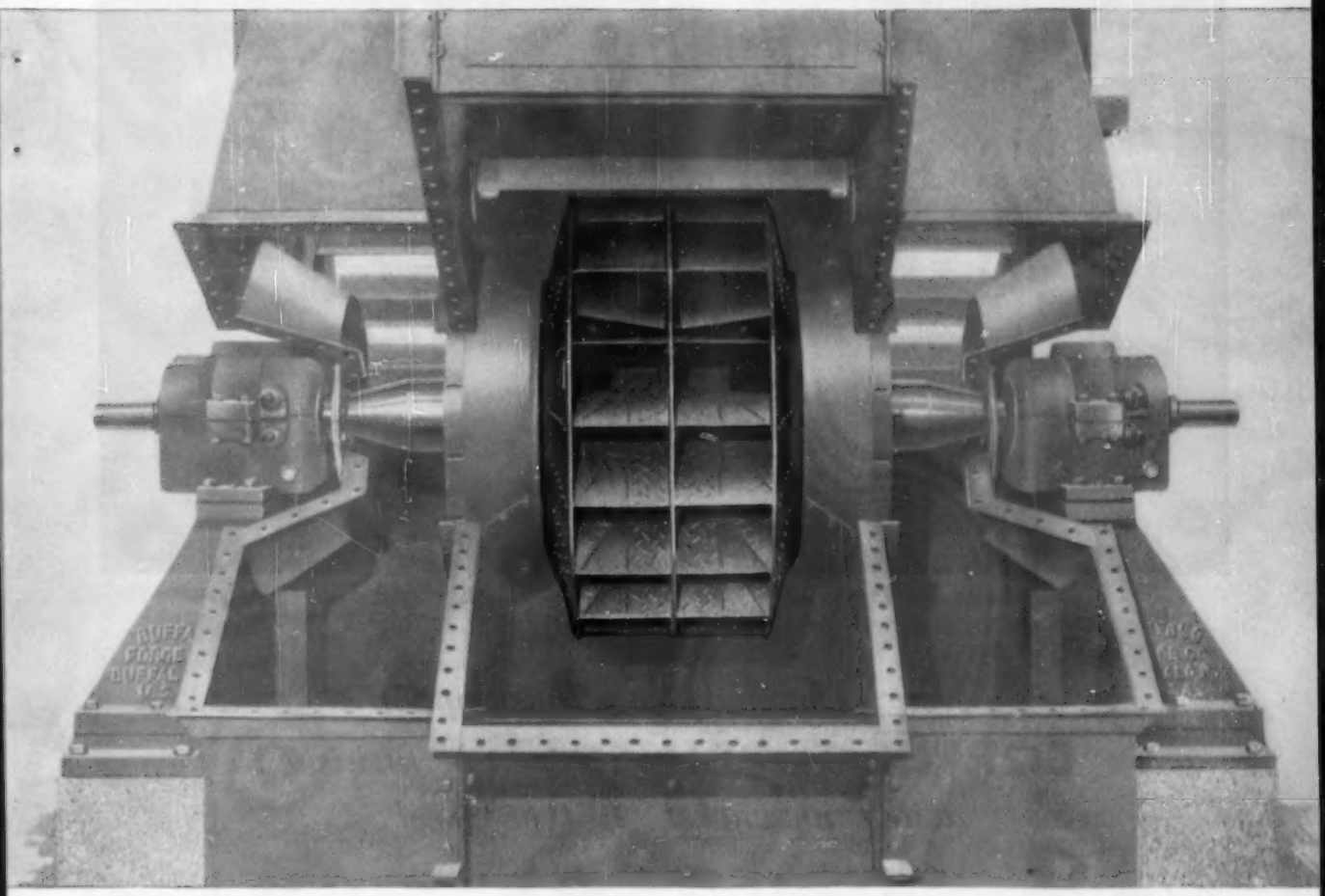
The bleed-off circuit shows a Denison Flow Control regulating cylinder speed. For bulletins about Denison Multi-Range Flow Controls, write to: THE DENISON ENGINEERING COMPANY, 1214 Dublin Road, Columbus 16, Ohio.




DENISON Hydr OIL ics

PUMPS • MOTORS • CONTROLS • PRESSES

# How a FAN ROTOR Delivers CHEAPER POWER



## . . . in "Buffalo" Induced Draft Fans

Inside the "Buffalo" Induced Draft Fan is a hurricane — a hurricane of hot, erosive fly-ash being drawn from the boiler firebed by a rotor like the one above. We don't have to tell you how quickly this could literally destroy an ordinary rotor—nor how expensive replacement would be.

Yet the "Buffalo" rotor is built to "take-it" for a long period. Heavy gauge steel used throughout; backward curved blades for extra stiffness and efficiency — tapered side flanges cut from a solid plate — floor plate wearing strips with angular ridges to reduce erosion — heavy hub solidly bolted to the center plate. And all other parts of the fan — housing, shaft and bearings — are built to "go the distance" for you, which naturally means cheaper power. It's all part of the "Q" Factor* that's in every "Buffalo" Fan. You'll see full details in Bulletin 3750. Write for your free copy today!

**The "Q" Factor—The built-in Quality which provides trouble-free satisfaction and long life.*

"Buffalo"

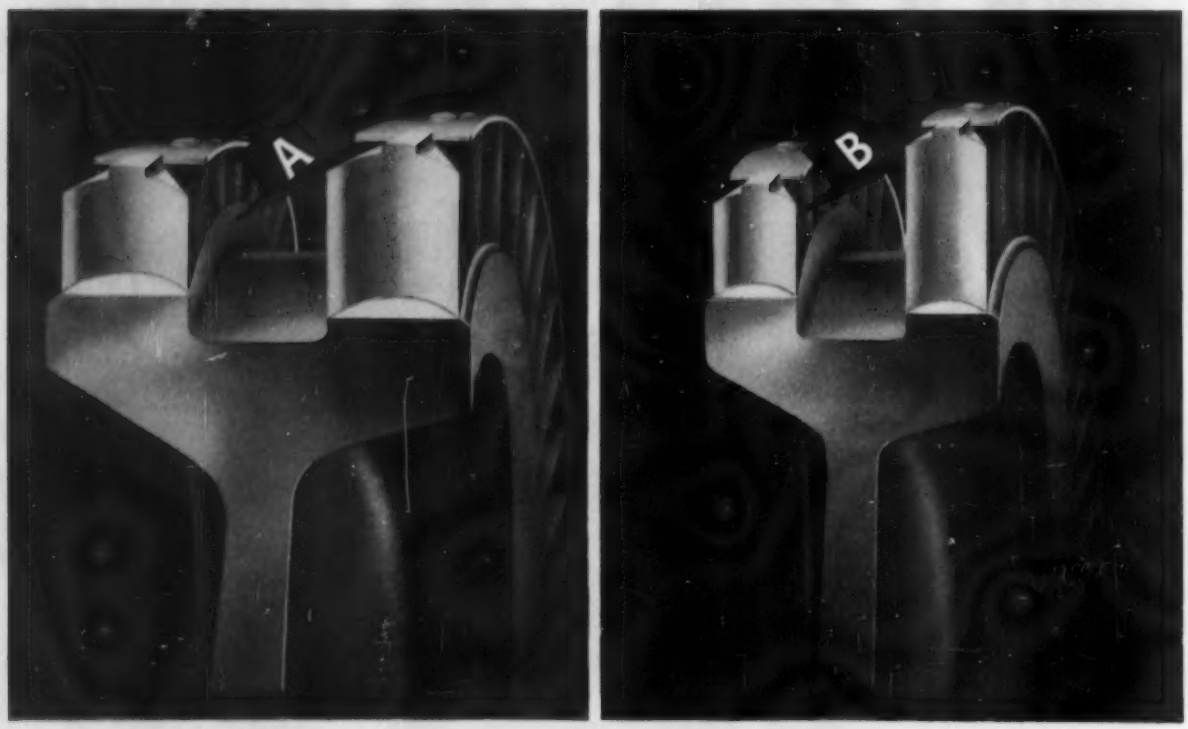
**BUFFALO FORGE COMPANY**

488 BROADWAY BUFFALO, N. Y.

*Publishers of "Fan Engineering" Handbook*

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.
Sales Representatives in all Principal Cities

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING




*(Left, A) wide bucket "L" type wheel. (Right, B) regular type wheel for Coppus Steam Turbines*

## *Now...for low steam consumption –* **COPPUS TURBINES** *can be furnished with wide bucket "L" type wheel*

Good news for steam turbine users where low steam consumption is important!

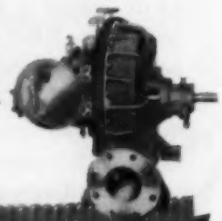
The Coppus Type "L" Wheel is the answer to this problem. Larger turbine buckets are employed to make the most economical use of steam.

In every respect the Coppus Turbine offers the top-quality features and advantages that have made the Coppus line outstanding for efficiency and economy. For example:

- Turbines rated close to your exact hp requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.

Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, *make turbine dollars go farther.* Send for Bulletin 135 on Coppus Turbine.

**COPPUS ENGINEERING CORPORATION**
161 Park Avenue
Worcester 2, Mass.
Sales offices in
THOMAS' REGISTER



# COPPUS "BLUE RIBBON" TURBINES

# Are you paying for soft water you don't get?

*Are you attempting to "get by" without a water softener or with one that is not delivering the quantity or quality of soft water you need? If so, the toll of hard water is far exceeding the cost of an efficiently operating water softener unit. You are paying for soft water without getting it, and you can't afford not to have a water softener.*

## Two ways to get all the soft water you need

Whether you need a new water softener or have one that needs reconditioning, Elgin has the answer to your requirements. For example, our water softener of "Double-Check" design has a deeper zeolite bed which increases soft water output as much as 44% to give all the soft water you need. It also prevents costly loss of zeolite to assure peak softening capacity year after year. The ingenious "double-check" manifold arrangement which makes this possible can be easily added to any existing water softener. It, plus Elgin high capacity zeolite can increase the soft water output of your present equipment 3 to 10 times. And to cut operating expenses still further, there is the Elgin Ultramatic Water Softener — the most efficient fully automatic water softener in America. Its automatic control mechanism is readily adaptable to any existing zeolite water softener.

Bear in mind that nearly a half century of technical "know-how" stands behind every Elgin Water Softener product. This experience assures the most advanced dollar saving equipment your money can buy. Ask for Water Softener Bulletin 611B, or better still, let us put our nearest representative in touch with you.

***These water softener diagrams tell the story***

ORDINARY MANIFOLD SYSTEM
LIMITED ZEOLITE SOFTENING CAPACITY
DOUBLE CHECK MANIFOLD SYSTEM
44% MORE ZEOLITE SOFTENING CAPACITY

**Ordinary Design**

**Elgin Design**

**Size for size, note far greater water softening capacity of the Elgin design.**

**Elgin-Refinite** • *Division of Elgin Softener Corporation*

**130 N. Grove Ave., Elgin, Illinois**

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Elgin REFINITE SINCE 1908

*Water-Conditioning since 1908*

### *Get this FREE Water Softener Check-up!*

I am interested in having a SECA Report (Softener Efficiency Cost Analysis) without cost or obligation.

NAME _____ POSITION _____

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*Mail to: Elgin-Refinite, Division of Elgin Softener Corporation, 130 N. Grove Ave., Elgin, Ill.*

ION EXCHANGERS • FILTERS • DEAERATING HEATERS • DEALKALIZERS • DEGASITORS • LIME-COAGULATION

announcing the NEW

# STRONG Hydro-Flex STEAM TRAPS

FOR LOW AND HIGH PRESSURE SERVICES TO 2500 PSI and 1100° F

**GREATER CAPACITY**

**LOWEST MAINTENANCE**

**UNMATCHED OPERATION ON LIGHT LOADS**

4/S

Here is a new standard of performance in steam traps —Strong "Hydro-Flex"!

This completely new line of low, medium and high pressure steam traps combines high discharge capacity with high efficiency under all condensate loads. This built-in flexibility can mean lower steam and maintenance costs plus higher production.

Strong "Hydro-Flex" meets the need for a trap that operates efficiently on light condensate loads. Under normal plant conditions many traps actually function at less than 1% of rated capacity. Strong's "Hydro-Flex" design makes possible high discharge rates when required, yet assures unequalled performance on low loads. This new concept in steam traps is the product of five years of development work and 50 years of steam trap experience.

Take advantage of this new, better standard of steam trap economy—standardize on Strong "Hydro-Flex". For complete details, contact your local Strong distributor or write for new Catalog No. SS-40.

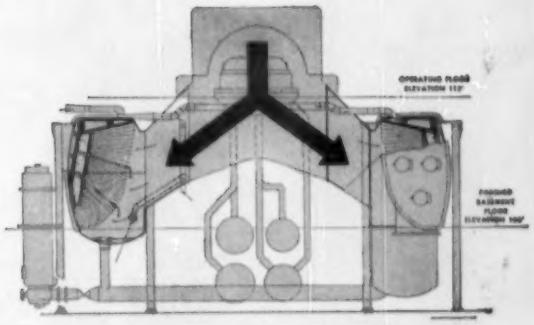
**STRONG HYDRO-FLEX STEAM TRAPS** — high efficiency under all condensate loads

Available from over 200 industrial distributors in the United States, Canada and foreign countries.

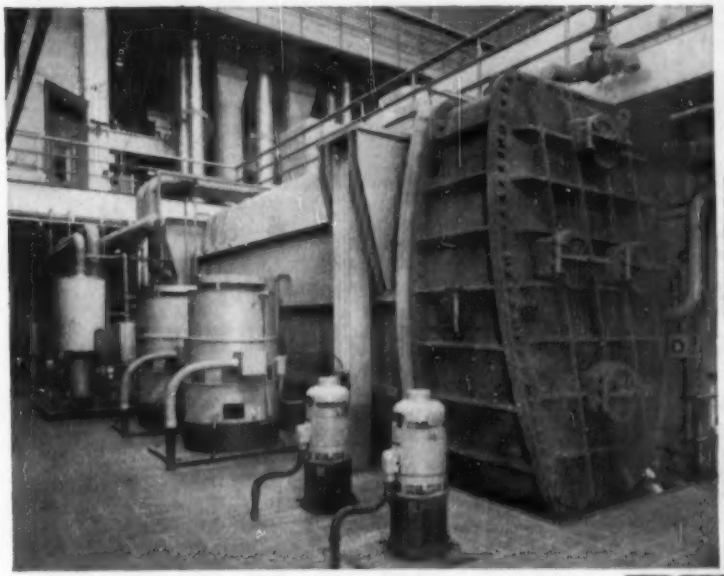
**STRONG, CARLISLE & HAMMOND CO.**
1965 WEST 3rd STREET • CLEVELAND 13, OHIO

# new angle

## in turbine-exhaust-condenser arrangement

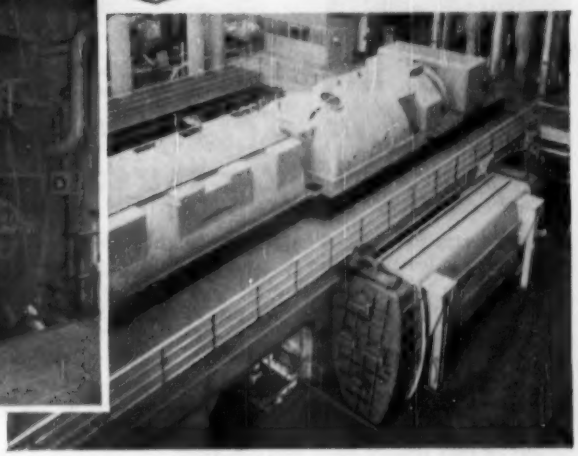


## saves headroom and construction costs at Kearny Generating Station



One of the FW side-mounted condenser shells from basement level, showing deflection columns, condensate pumps and heater drain pumps.

General view of turbine room at Kearny station, showing one of the twin condenser shells and the side-exhaust turbine.



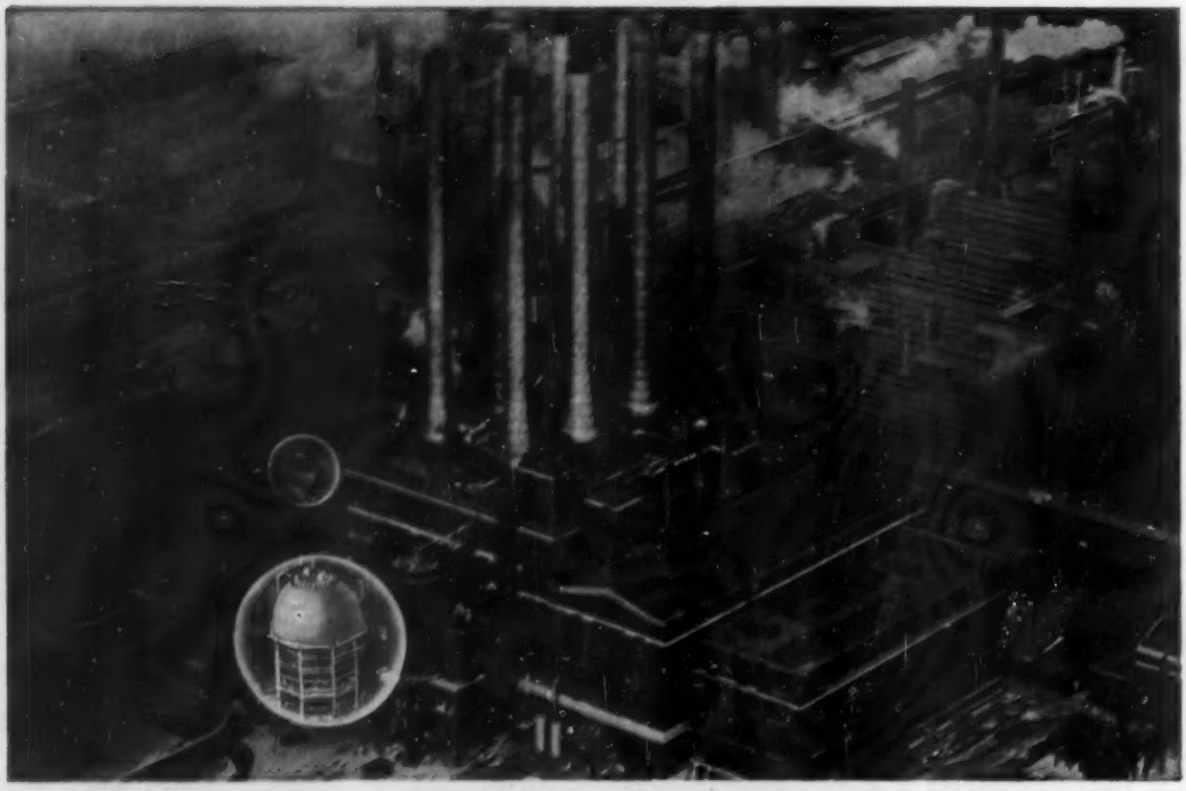
The slightly unorthodox surface condenser illustrated above is one of two 70,000 sq. ft. side-turbine-exhaust units designed and built by Foster Wheeler for Public Service Electric and Gas Company, N. J. Serving a 145,000 kw turbo generator at the new Kearny Generating Station, it has effected important overall economies in station construction.

Total height from basement level to turbine operating level is only 15 feet. This low height was achieved without appreciable increase in turbine discharge path, which feeds directly into the twin single-pass condenser shells through a short divided exhaust piece. Careful studies showed that the reduction in headroom was a definite economic advantage. The space below the exhaust piece is effectively utilized by four feedwater heaters.

Each half of the condenser shell is suspended from four deflection columns which allow for thermal expansion without the customary expansion joint or spring arrangement.

Specializing in the design and construction of steam generators, surface condensers and feedwater heaters, Foster Wheeler is fully equipped, engineering and productionwise, to meet your requirements for the modern steam plant. For further information write for HE-3-54. Foster Wheeler Corporation, 165 Broadway, New York 6, N. Y.

**FOSTER WHEELER**



# FORD RIVER ROUGE POWER PLANT

## *modernizes water system with*

## Cochrane HOT LIME ZEOLITE

A Cochrane 200,000 gph Hot Lime Zeolite System answers the treated water requirements of higher quality and increased capacity at the world-famous Ford River Rouge Power Plant . . . and at an estimated savings of $49,000.00 a year in operating cost!

The Kuljian Corporation, consulting engineers, in collaboration with Ford engineers, have assured adequate feedwater supply for the boilers. Ample supply is also available for future high pressure boilers even though the service may require 100% makeup water.

The system consists of one of the world's largest single unit, Sphericalhead design, hot lime softeners to reduce alkalinity to 25 ppm, a battery of pressure filters to remove turbidity, and hot zeolite softeners to produce an effluent practically free from hardness.

To provide oxygen free feedwater, a Cochrane deaerating heater with a capacity of 1,500,000 lbs./hr. follows this Hot Lime Zeolite plant.

*Cochrane is the pioneer and largest manufacturer of hot process softeners and deaerating heaters.* Hundreds of early hot process installations have been converted to Hot Lime Zeolite by Cochrane, with resultant high quality water such as that required by Ford's River Rouge Plant.

If your problem is a new installation or the conversion of an old plant, our engineering background in water conditioning will provide the most economical method to meet your requirements. Why not contact Cochrane today?

**Cochrane**

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LOUIS N ROWLEY, EDITOR • JANUARY 1955 • ESTABLISHED 1882 **Power**

# Program for 1955

THROUGHOUT THIS ISSUE, the idea of modernization pops up at frequent intervals. That is, of course, deliberate. We think modernization is important. We thought so back in 1953 when we first announced a program of awards to encourage and stimulate it. We thought so when we saw the results of that program. We still think so as we announce (p 80) the 1955 Modernization Awards.

Of necessity, these awards will recognize successful modernizations of the past. But now, at the onset of a new year, we want to look ahead, to look at the modernizations that will be planned this year and will pay dividends in years to come.

How long is it since you turned a really tough eye on all phases of your power-service operations? That's where profitable improvements start—with a fresh look at what you're doing now. Incidentally, a consultant can be a big help when a really unbiased view is needed.

A good place to start is with your manpower needs. Man-hours are the most expensive item you buy these days—be sure you don't use human muscle and human skill where machines and automatic controls will do the job faster, better, cheaper. Remember, too, man-hours are the big ingredient in maintenance operations—reducing need for maintenance can be a big profit factor in favor of modern equipment.

This is no place to list all the spots in a typical power-service operation where that fresh look will turn up profit opportunities. The important thing is to start looking and then to do something about it.

Doing something about it means "selling" the modernization program to management. And, for that, 1955 should be a good year. Our December 1954, report "New Profit Opportunities" lays just the groundwork needed to insure an interested audience for your ideas. If you haven't put a copy of it in the hands of your top management, do so immediately. Special reprints are available for that purpose.

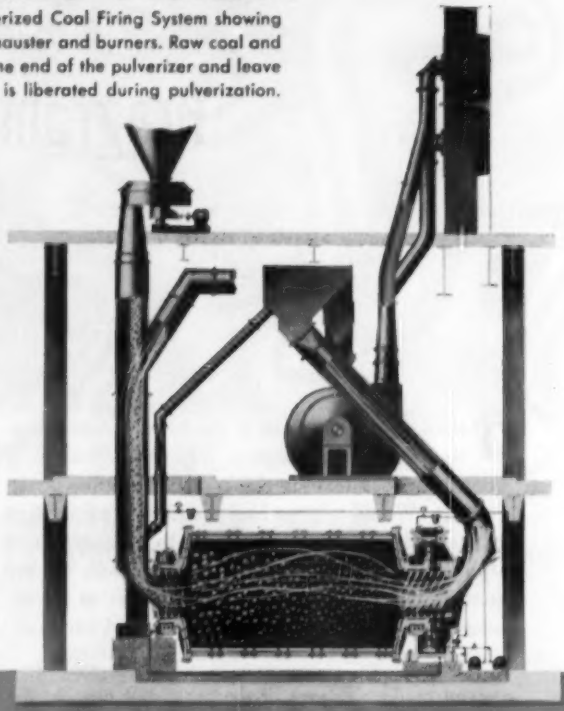
And if you need case studies to prove your points, check back over the Mid-September 1954 issue for ideas gleaned from successful modernizations, watch for upcoming articles on citation-winning projects.

There you have it—a 1955 program for future power-service profits. Examine your operations, spot the places where new equipment means big savings, sell your ideas. Our New Year's wish for all power-service men is simple—good hunting for the profits these competitive times demand!

# Coal Facts Become WHEN DOLLARS

## KVS COAL FIRING SYSTEM

Cutaway drawing of Kennedy Pulverized Coal Firing System showing disc feeder, pulverizer, classifier, exhauster and burners. Raw coal and pre-heated air up to 750°F. enter one end of the pulverizer and leave the other end. Moisture in the coal is liberated during pulverization.



With the KVS Pulverized Coal Firing System you can give your steam plant a "lift" by burning the cheapest grades of coal and still obtain results in heat values obtained from the most costly fuel. Think of the savings in dollars this can mean!

The KVS Coal Firing System obtains maximum heat value from every ton of coal burned. No other system produces comparable results . . . no other system provides such drastic savings in coal costs.

A feature of the KVS Pulverized Coal Firing System is extremely fine pulverization . . . 85% to 90% through U. S. standard 200 mesh . . . making pulverized fuel instantly available to meet fluctuating loads with quick, flexible response to combustion control. The result: more heat to produce more power from any given quantity of coal.

IT COSTS LESS TO OWN THE BEST!

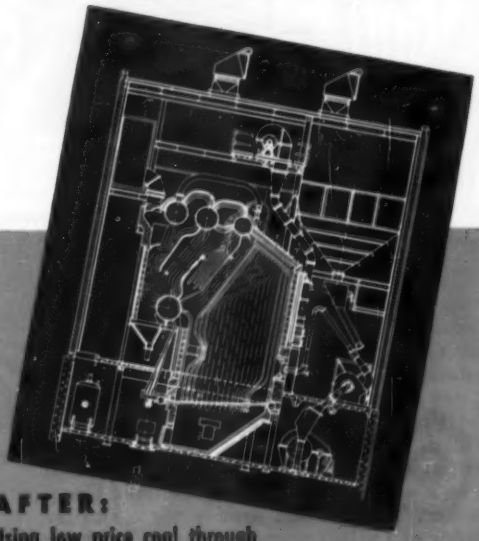
**BEFORE:** Using premium coal on stokers.

TWO PARK AVENUE • NEW YORK 16, N. Y. • FACTORY: DANVILLE, PA.

# "Cold Facts" . . .
# ARE INVOLVED

## You can save up to $3.00 per ton on your coal costs with

## KENNEDY
## PULVERIZED COAL FIRING EQUIPMENT



**AFTER:**
Using low price coal through pulverizers.

**FEATURES OF THE KENNEDY PULVERIZED COAL FIRING SYSTEM**

FULLY AIR SWEPT

COAL PULVERIZED TO SUPERFINENESS

COAL COMPLETELY CARBURETED
Ready for combustion

BIG TRUNNIONS FOR AIR SWEEPING

BALLS ADDED WITHOUT SHUTTING DOWN

LOW OPERATING AND MAINTENANCE COSTS

UNBURNT CARBON LOSSES LESS THAN ½%

INSTANT RESPONSE TO CONTROLS

85% TO 90% THROUGH 200 MESH

20% MOISTURE REMOVED WHILE PULVERIZING

PULVERIZES ANY COAL, BITUMINOUS, ANTHRACITE, COKE BREEZE .

TRAMP IRON ACTUALLY AIDS IN PULVERIZING

RESERVE OF FUEL FOR INSTANT RESPONSE AND STEAM DEMAND

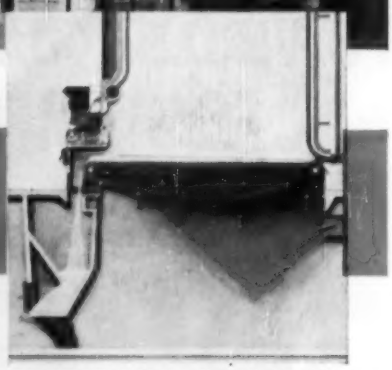
# KENNEDY-VAN SAUN

## MANUFACTURING & ENGINEERING CORPORATION

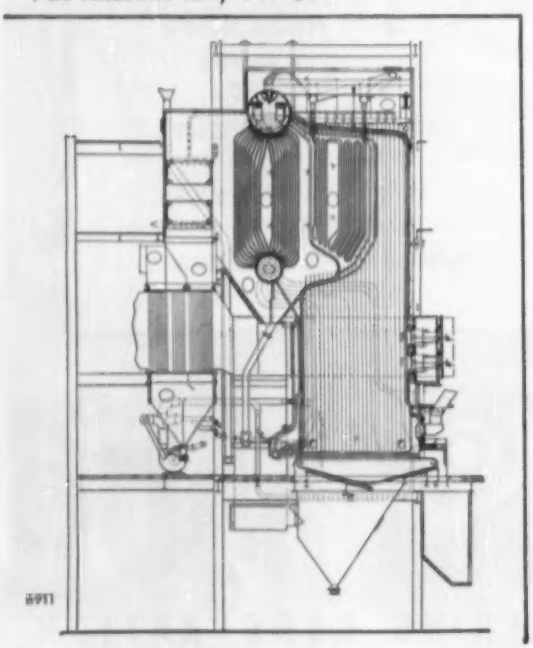
Vineland Municipal Electric Plant; Howard M. Down, General Manager of Municipal Utilities.

# Fuel Savings by First Installation

## BRING SECOND CONTRACT AT VINELAND MUNICIPAL ELECTRIC PLANT VINELAND, N. J.



Detroit RotoGrate Stoker—the original spreader stoker with forward moving grates that continuously discharge the ash at the front.




In 1950 this plant installed its first Detroit RotoGrate Stoker with a B&W Two-Drum Stirling Boiler with Superheater, Economizer and Air Heater; designed for a capacity of 100,000 pounds of steam per hour . . . 625 psi . . . 835°F . . . feedwater 354°F. Burners for auxiliary oil burning are provided.

Substantial economies produced by this unit resulted in a second order for a Detroit RotoGrate Stoker. This second unit is for a similar B&W Boiler of 130,000 pounds of steam per hour capacity . . . 875 psi . . . 910°F . . . feedwater 390°F. Design is based on eastern bituminous coal—12,700 BTU, with air preheated to 300°F.

This repeat order was based on the solid performance for which Detroit Stokers are noted.

They can save *you* money. Write for recommendations. No obligation.

## DETROIT STOKER COMPANY

**General Motors Building—Detroit 2, Michigan**

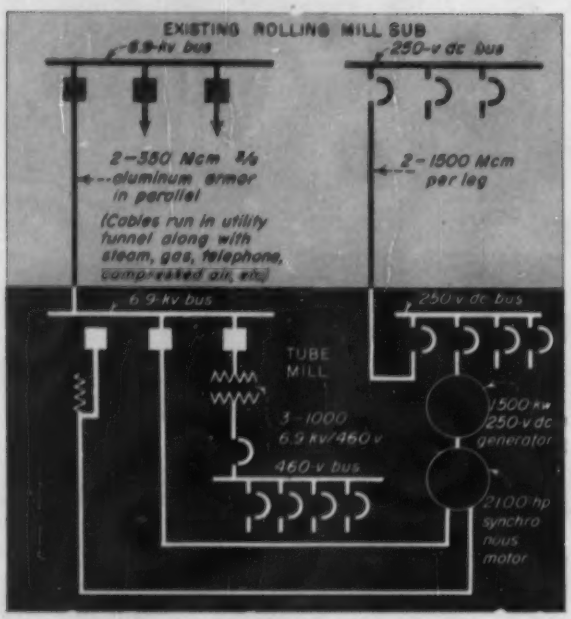
***District Offices in Principal Cities • Works at Monroe, Michigan***

# Cable troughs, says Bruce Forbes, and our...

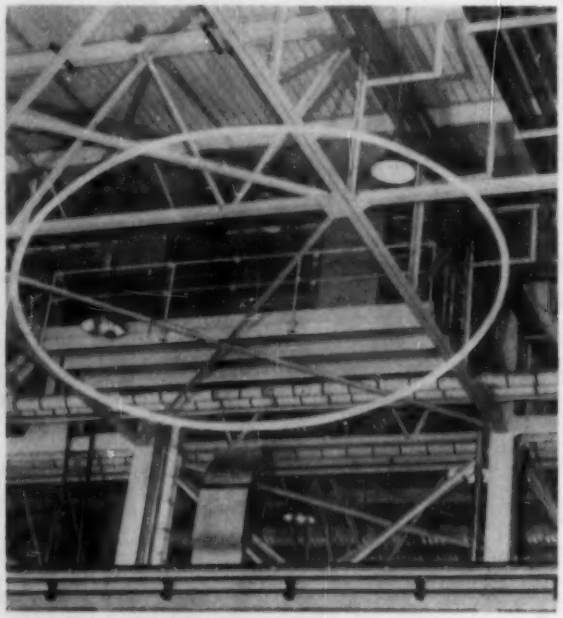
# new color-improved mercury lighting are...

# Two electrical designs that pay off

A spanking-new tube mill, most recent arrival of Bridgeport Brass Co, boasts an electrical distribution system that doesn't follow the load-center trend. Yet it represents a well-engineered layout where all feeds and subfeeds, both ac and dc, are carried in expanded-steel cable troughs. Color-improved mercury lighting beams 60 ft-c on inspection areas. Top electrical man is Bridgeport's Chief Electrical Engineer Bruce G Forbes. *Now turn page*


EXISTING ROLLING MILL SUB
6.9-kv bus
250-v dc bus
2-350 Mcm 3/c aluminum armor in parallel
2-1500 Mcm per leg
(Cables run in utility tunnel along with steam, gas, telephone, compressed air, etc.)
6.9-kv bus
250-v dc bus
TUBE MILL
3-1000 6.9 kv/460 v
460-v bus
1500-kw 250-v dc generator
2100-hp synchronous motor

**PLANT LOAD** includes three draw benches equipped with Ward-Leonard drives. Setup requires 200-kw synchronous motor-generators, feeding to 200-hp main-drive motors on the machines



**DISTRIBUTION CENTERS** are spotted off the floor in building trusses. No valuable production space lost. And maintenance can be carried on without interfering with plant operation

## Overhead power-distribution centers, set up to channel 460-v loads,

► METAL CABLE TROUGHS played a key role in this distribution scheme. About 1½ miles of the expanded steel troughing was used. Where at all practical, ac and dc feeds and subfeeds are carried in troughs. Control and branch circuit wiring is generally run in conduit or fiber ducts. The exception to this application pattern may be found in the basement cables room right beneath the motor room, see drawing on facing page. Here, control wiring from switchgear and equipment in motor room drops through the floor directly into cable troughs. Wiring is then carried in trays to basement wall and there picked up by fiber duct.

**Why use trays?** There are a string of supporting reasons why Forbes went to cable trays in this installation. But they all add up to lower over-all cost and added flexibility. Installation was far simpler compared to conduit, especially where splices were needed in overhead runs. *Design tip:* Where splices are made in heavy cables lying in troughs, wood blocks are placed under cable on both sides of splice point. This precaution prevents the insulated splice from abrading on the trough bottom. It also holds the splice in free air.

Straight metal troughing is available in 8-ft sections in standard widths of 6, 12, 18 and 24 in. All are 3 in. high, including the steel binding strip. Units are butted to each other or to fittings, forming any length of raceway. On this installation loading varied from 4 to 20 lb per foot.

It is interesting to note the development of expanded metal cable troughs as a significant wiring medium in industrial plants. Rigid conduit has been the backbone of industrial wiring systems for generations. In the days of lower labor costs, necessary cutting, threading and bending wasn't as critical. And there was no substitute that offered all the advantages of conduit: top mechanical protection, good electrical conductivity, rigid structural support.

Then during the 1930s, thin-wall conduit began cutting its teeth in industrial plants. It offered light weight, easier cutting and, of greater value, no threading. Compression couplings and terminal fittings, slipped over the new conduit, permitted installation with only hand tools. But thin wall was just the beginning of a concentrated effort to find low-cost, easily installed raceways. Today, an increasing number of engineers feel cable troughs offer simple installation at low cost. The tray technique is particularly well suited where many wires and cables are carried in the same general area.

**Knotty problems** in design, fabrication and installation that popped up in this tube mill installation were simplified with cable trough. It fast proved itself as a sturdy raceway of varying widths, at different levels, and in any direction. One man can easily handle a section. Fittings allow for turns, branches, changes in elevation. They make odd angles and tight corners almost as easy as straight runs. Troughing is cut and bolted together on the job.

Steel hangers support overhead troughs. Hangers are welded in place, troughs laid in position and cable pulled in. *Design tip:* You get a better job when cables are pulled in singly rather than three together for a 3-phase feeder. Taking them one at a time prevents cables from winding about each other during pull-in.

**Plant lighting** harbors a few timely tips. Lamps are 1000-watt color-improved mercury (also called fluorescent-mercury) in ventilated aluminum reflectors. Average of 60 ft-c is maintained on inspection areas, constituting about 15% of the plant area. Remaining plant work space is kept at about 45 ft-c.

Feed for plant lighting is off the 460-v ungrounded system. *Design tip:* To meet NEC requirements isolating transformers are inserted between supply and lamps. Primaries are delta, secondaries wye with grounded neutral. This setup

**TROUGH FITTINGS** are available that allow for turns, branches and elevation changes. They make odd angles and tight corners a cinch. Above runs are headed for the distribution centers

## are fed from metal cable troughs

gives 460/266 v on the load side of the isolating transformer holding voltage to ground within the 300 v figure. Isolating transformers are housed in the overhead power-distribution centers.

Lamp control is from six button stations on the production floor. Magnetic contactor on the primary side of the isolating transformers cuts lamps on and off. In the 60 ft-c areas, mercury lamps are spaced 20 ft apart on 26-ft rows. In the 45 ft-c sections, lamps are 30 ft apart on the same 26-ft rows.

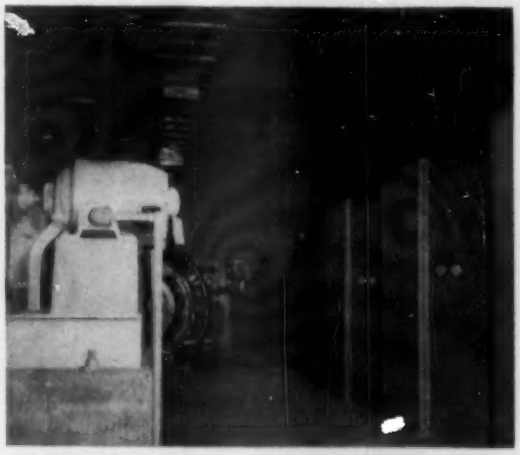
**Why color-improved mercury?** *Design tip*: The big factor in pinning down the type lighting was the *owning* cost, carefully worked out for each lighting plan that was reasonable. *Owning* cost rings in all costs: initial, operating and maintenance. A $1.00 base was set up for straight mercury vapor (not color-improved) alternating with incandescent. Cost tallies for a color-improved lighting installation were $.86 against a high of $1.06 for straight fluorescent.

Relatively high maintenance cost is reason for the high figure on straight fluorescent.

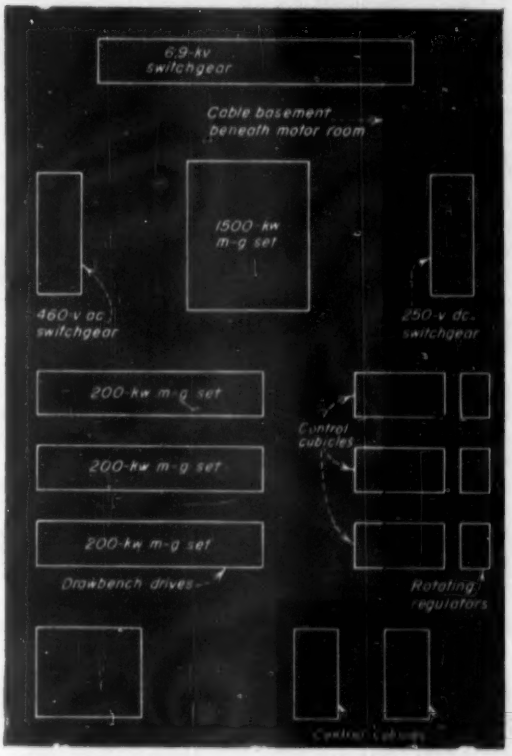
**Safety lighting.** Because it takes anywhere from 6 to 8 minutes to start a mercury unit, a staggered 750-watt incandescent lighting system was installed to provide some light if power failed or voltage dipped, extinguishing the mercury lamps. Incandescents are fed from a 3-phase 4-wire system, 208/120 v. When mill is shut down, about 20% of the incandescent lighting remains on, serving as watchman lighting.

**Electrical system** for the tube mill starts in 6.9-kv switchgear at existing rolling mill substation. This sub is fed from the utility company through a set of auto-transformers that step the 14-kv utility supply down to 6.9 kv. Two 350-Mcm 3/c aluminum-armored cables in parallel form the feed between rolling mill and tube mill subs. These feeders end in modern high-voltage air-break switchgear which, in turn, serves a 3000-kva 6900/460-volt outdoor transformer bank. In addition, the high-voltage lines service a 2100-hp synchronous motor driving a 1500-kw 250-v dc generator.

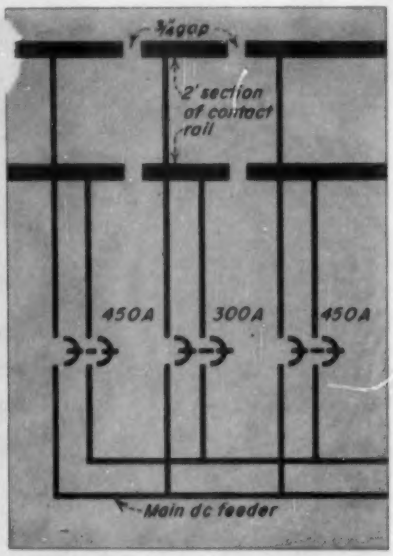
**Plant distribution.** The 460-v power from 3000-kva transformer bank is distributed through draw-out type air-break switchgear. Likewise, the dc generator output is distributed through dc switchgear. Because of a bus-tie arrangement the tube mill can draw from the plant's 5200-kw 250-v dc pool. The dc system plays an important role in the tube mill



**MOTOR ROOM** is alongside outdoor transformer substation. Conversion of ac to dc for plant machines is main job here. Cable room is directly beneath the right section




**ALL CABLE RUNS** in basement are carried in troughing. With this setup it's simply a matter of dropping right from switchgear or control equipment into cable trays




**ISOLATING SECTIONS** are inserted at one-third points along dc contact rails for traveling cranes. This safety feature prevents an active crane accidentally rolling into a de-energized section, making it momentarily live while men may be working in area

**SEPARATE BREAKER,** banked beside those feeding adjacent contact rails, permits simple control of the isolating section

since much production equipment is driven by dc motors.

Motor-generator room, photo previous page, is adjacent to the primary sub. Here you find the various m-g sets, control equipment and switchgear. Three 200-kw synchronous-motor m-g sets connect to three 200 hp on draw benches on the production floor. Each of these three draw benches is equipped with a Ward-Leonard drive. And the main control gear as well as the m-g sets are located in the m-g room. Incidentally, this room has an air-cooling and filtering system.

**Distribution of ac** throughout the plant is at 460 v. On the surface this appears contrary to the growing load-center trend (see POWER, Oct 1953, p 86). However, in light of two important factors, load geometry and availability of equipment, the low-voltage radial system was justified. Load geometry enters the picture because of the heavy need for dc, which is generated in the motor room adjacent to the high-voltage primary substation. Thus, a big chunk of the plant load is satisfied at this point without requiring long low-voltage feeders.

Equipment availability was a factor in deciding on a non-load-centered system because of the three 1000-kva oil-filled transformers used in the primary sub. Actually, these transformers are over 35 years old, having seen much service with induction melting furnaces.. But with some rebuilding before placing in service, they hold the promise for many years yet.

*Design tip*: Even though the load-center technique was not adopted, there are six overhead local power-distribution centers. These are spotted in the building trusses where maintenance work can be done without interfering with operation of the eight traveling cranes. The heavy 480-v feeds are brought into switchgear at these points and circuit breakers protect the sub feeds running out.

**Traveling cranes.** *Design tip*: Overhead cranes have their contact rails sectionalized as a safety measure. A 2-ft section of isolated contact rail is installed at about the one-third points in the dc contact rails. Now, should an active crane move into an isolated section, it cannot momentarily energize the contact rails where men may be working.

**CRANE LIMIT SWITCH** came in for close scrutiny, too, in over-all plan to design modern electrical system for maximum safety. Limit-switch setup under crane cabs was one area that harbored a potential accident. Using a single-bar limit-switch arrangement, operator could lift spreader up beyond safe limit. He could do this without operating limit switch, if load was lifted just beneath the bar's fulcrum or toward unprotected side.

But this hazard is eliminated by inserting new auxiliary bar in position shown. Now limit switch snaps into action if spreader is lifted beyond the safe point in any direction under cab.

**FISH IN TEST FLUME** swim upstream for dear life to avoid being pinned against screen, *at left.* In actual circulating-water intakes, water current traps fish that happen to pass the inlet opening. The strong swimmers escape by fast action

# How to unscramble fish from your power-plant cooling water

**In using a natural resource like river water a plant must make sure not to kill desirable fish needlessly. Here's what one utility did, as a good neighbor on a fishery used by both sportsmen and commercial fishermen***

► STARTUP of the first three units of Contra Costa Plant of Pacific Gas and Electric Co in the summer of 1951 caused an alarming mortality of fish caught in the circulating-water intakes. Water enters the system at intakes 410 feet offshore, see photos next page. Initial flow velocity through tubes from intake to screens was 2.7 feet per second, and final flow with six units at full load will be 3.8 feet per second.

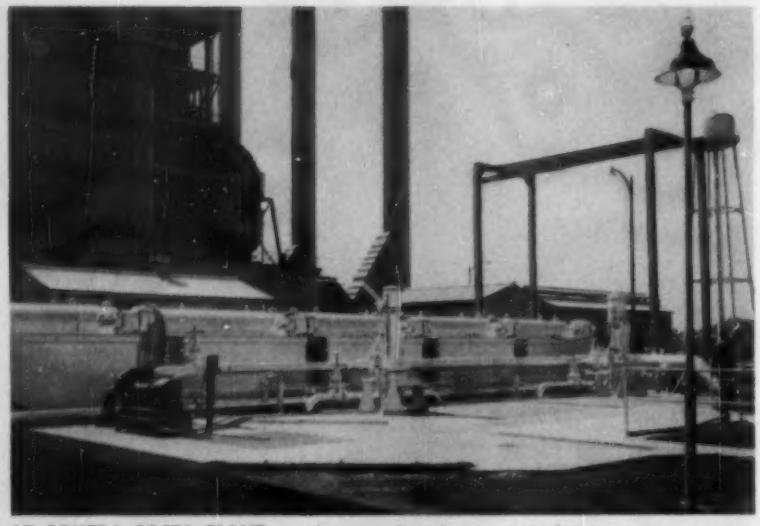
Calculated screen-approach velocities average about 1.3 feet per second and through the screen openings about 2.0 feet per second. Fish caught in the flow take about four minutes to pass from screens through the plant to the discharge structure.

**First rescue measure** was hand-dip netting in front of traveling screens. During high fish concentrations netting was carried on seven days a week, 24 hours a day. From August 30, 1951 to November 1, 1951 about 12,000 bass, 2 to 16 inches long were rescued and returned alive to the river. Subsequently a mechanical-dip netter replaced the hand-dip netting with equal success and fish survival.

While this workable but expensive method of rescue was carried on efforts were made to find a more practical solution. Noise, vibrators and lights were tried in directing fish from the danger area. None of these offered a workable answer to the problem.

Initial design of the plant had included a vertical fish lift consisting of two 8-inch-diameter pipes. These were slotted and projected vertically into the approach channel just three feet ahead

*Abstracted from (State of California Department of Fish and Game) Fish Bulletin No. 92, "Studies of Fish Preservation at the Contra Costa Steam Plant of the Pacific Gas and Electric Co," by James E Kerr, Bechtel Corporation.



**AT CONTRA COSTA PLANT** one horizontal and two vertical fish pumps, standing on inlet sides of five water screens, discharge fish-bearing water to common line

**CIRCULATING-WATER INTAKE** at Contra Costa Plant stands in San Joaquin River teeming with fish. Striped bass spawn in this area while salmon migrate up river

of the screens. A hydraulic eductor in the manifold connecting these pipes developed a high-velocity flow. Designers thought that the fast flow into the slots of the vertical pipes would catch the fish so they could be returned to the river.

Initial operation showed the lift removed few fish and many of these were killed. It removed up to 32 bass per hour, 2 to 7 inches long, but only 13% survived.

**Research program.** As trial-and-error methods failed to find a solution, it became evident that thorough study of at least a one-year cycle was needed. Natural fish life in the river changed continuously. Eggs of one day become larvae two or three days later and 2- or 3-inch fish within several months. Life cycles of the many species do not coincide.

Two broad classes were involved: Resident fish include over 22 species. These spend their entire lives in the area. King salmon and striped bass pass through the river en route between the ocean and their upriver spawning grounds. Many striped bass spawn in the area. Research effort was concentrated on these two valuable species with the thought that rescue methods effective with them would benefit all other fish.

To study fish behavior an elaborate system of test flumes, holding tanks, aquariums, pumps, and a personnel shack were set up at the station screen structure. This laboratory was manned continually for the duration of the research program. A biologist from the State Department of Fish and Game acted as consultant to the project director.

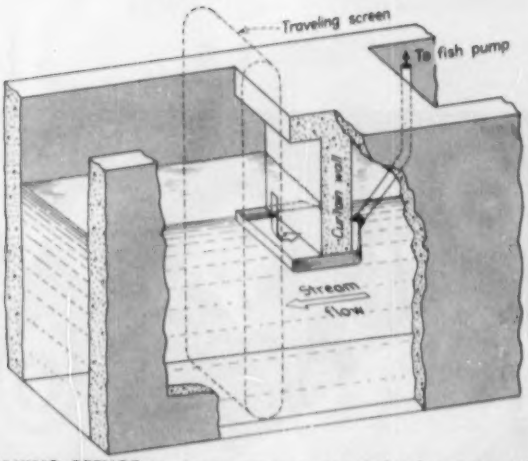
**Research results.** Laboratory tests showed that fish swim in all directions in quiet water. The instant water begins moving in a flow, fish align themselves, heading upstream, with very few exceptions. Fish seem to swim with the current only when frightened or exhausted and desperately looking for refuge. They swim against a current because it makes breathing easier as well as catching of passing food.

Fish avoid regions of high turbulence and do not cross "surfaces" separating flows differing greatly in speed. They sense and seek areas of lower uniform velocity. Striped bass and salmon sense a screened obstruction before reaching it. If the current is slow enough they swim away from the obstruction. If the current equals their swimming speed they move laterally in front of the obstruction, heading away from it, looking for a slower-speed stratum.

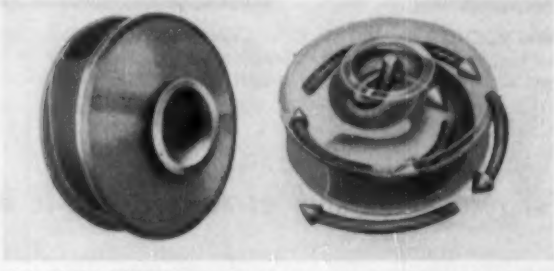
Only when a fish becomes exhausted or the current is stronger than its swimming speed does it become pinned against the screen. Trapping in this way kills smaller fish. Observations showed that fish can be carried in water currents moving at 10 ft per sec, but sudden changes in water speed are dangerous for them.

**Velocity barrier.** Long, circular, V- and U-shaped obstructions placed in the test flume in various positions showed how fish behaved. When the obstructions were in vertical positions or at 45-degree slopes, the resulting vertical water surfaces, separating water moving at different velocities downstream from the obstructions (velocity barrier), effectively barred fish from hiding behind them. But when these same obstructions were placed horizontally just below the water surface or on the flume bottom, fish congregated behind them without hesitation. These evidently give them refuge from the faster-moving water currents above or below.

**FISH COLLECTOR** at top extends under curtain wall toward inlet side of screen. Pipe connects to suction of fish pump




**TAKING REFUGE** in slower-moving water behind curtain wall, fish are caught in suction of fish collector, removed by pump



**FISH-PUMP IMPELLER** of bladeless type resembles twisted pipe with no projections that can catch and hold solids in the water

**Fish collector.** After many trials the collector, shown in upper right, above, was developed. Fish were found to collect behind the curtain wall in front of the screen because this was evidently a lower-velocity region. The first collector was a pan six inches deep, hung from the under side of the curtain wall, see sketch and photo, above. Pan lip projected into the refuge area about five inches from the traveling screen and extended across the full width of the channel. Top of pan was open beyond the curtain wall. At this wall it was covered and converged to a 6-in.-diameter suction pipe connected to a fish pump at floor elevation of the screen structure, see photos, p 78 and above.

Fish taking refuge behind the curtain wall were caught in the flow to the pump suction, gradually accelerating until entering the 6-inch pipe. The flow of 550 gpm did not injure them. The fish pump uses a bladeless-type impeller, also used in trash and sewage pumps, see sketch above.

**Final installation** for the five traveling screens at Contra Costa included a fish collector ahead of each screen. A horizontal 5-inch fish pump serves one collector, and each of two vertical 8-inch fish pumps serves a pair of collectors, see photo, top p 78. All three pumps discharge into a common line that empties into the river.

Many experiments lead to the conclusion that this system of collectors and pumps removes fish from the screen intake structure in a short time, at several hundreds per hour. Over 98% of the fish returned to the river survive the removal process without ill effects. The system handles fish up to 14 inches in length. Estimates indicate that the collectors recover yearly about 560,000 juvenile striped bass alone. Considering all species of fish, apparently many more will be returned to the river. Mortality of striped bass in passing through the recovery system is less than 0.2% of the estimated annual bass take of 1,500,000 fish. We can safely say that Contra Costa Plant now does not constitute a threat to fish in San Joaquin River.

**Temperature effects.** Fish eggs and larvae and small yearling bass and salmon have very little motive power. They drift pretty much with the current. Being small, they pass through the traveling screen into the plant cooling system. Experiments consisting of passing yearling bass through the main condensers showed they can stand a temperature rise of 16 F and a top temperature of 90 F. This experience killed only 10% of the bass. Yearling salmon, on the other hand, can survive a 25-F rise and top temperature of 83 F without loss of life.

No data were reported on the effects on fish eggs and larvae. However, fish experts estimate that of 35,000,000 fingerlings born annually in the area, only 5% survive to become adults in the normal course of events. All in all, it appears that fish breeding in San Joaquin River feels no significant effect from the 868 cubic feet per second diverted for cooling by Contra Costa Plant.

**Pittsburgh design.** Design of the Pittsburgh plant of P G & E profited from the research carried on at Contra Costa. This plant will use 900 cubic feet per second of cooling water.

The screen structure was directly on the edge of the bay at the point of actual water diversion. Traveling screens are arranged in the structure to present a smooth continuous face for the entire length of seven screens. No screen channels or pockets are used

(*Continued on page* 198)

**NEW ROCHELLE HOSPITAL:** Chief Engineer Al Miller holds citation awarded for hospital's modernization program. Looking on *(l to r)*: W W Sheppard, asst supt; Lou Rowley, editor, *Power;* Richard Reynolds, hospital treasurer

**ELMIRA FOUNDRIES:** Works Manager Ralph Roberts looks at citation for electrical modernization, presented by Assoc Ed. Jim O'Connor

***For recognition such as came to the 18 winners of 1954 citations . . .***

# *Prepare now to enter the 1955 Program of*

■ **Modernization is always a good idea but it has special importance now, as growing industrial competition puts the squeeze on power costs.**

■ **That's why we set up the Modernization Award Program—to encourage planning for future modernizations by recognizing meritorious completed programs that demonstrate what can be done.**

■ **In 1954, 18 citation-receiving plants—large and small, of all types—racked up annual savings in excess of $3 million. Besides showing how profitable modernization can be, they yielded a fine crop of ideas for other modernizers.**

■ **Now we announce continuation of this basic program—new Modernization Awards for 1955.**

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**YOUR OPPORTUNITY.** If you have completed a modernization job during the past two years (calendar 1953 and 1954), here is your opportunity to have your engineering skill and judgment recognized. Through the pages of POWER the results obtained in your plant will be made known to your fellow engineers across the country. And plants selected for outstanding accomplishment will receive a citation that may be proudly displayed.

**WHO IS ELIGIBLE?** Entries may be made for any type of plant—steam, diesel or hydro—in any service—industry, institution or utility. Small installations will receive the same consideration as large ones.

Modernization may involve the entire power-service system or any major part of it—boiler plant, generating equipment, electrical distribution, heating, air-conditioning, refrigeration, mechanical-power transmission, compressed-air or water systems.

**BASIS OF JUDGING.** POWER's editors, assisted by advisory experts, will do the judging, putting emphasis

**WALDORF-ASTORIA:** Bill Knecht, of Seelye, Stevenson, Value and Knecht, accepts citation from Lou Rowley. Knecht's associate Erik Roos (*left*), Tom Barrett, bldg supt, look on

# *Modernization Awards*

on the gains resulting from modernization and on the ingenuity with which problems were solved.

**WHO MAY SUBMIT ENTRIES?** Most will come, of course, from power-service staffs, but consultants may enter for their clients. We will welcome suggestions and leads from anyone in the power field who knows of a meritorious modernization project.

**EASY TO ENTER.** To make it easy to tell us about what you've done, we've designed a simplified entry blank. By answering the streamlined questions on it, you can quickly give us the data we need about your job. For an idea of the kind of information wanted, and other details of entering, see the column at the right.

**ENTER NOW.** No matter how good a job you may have done, or how proud you may be of the results, you can't win an award for it unless you enter. So do it now! Then you'll have a chance to win concrete evidence of the worth of your accomplishments—recognition you and your top management will be proud of for years to come.

## How to submit entries

1. Entries will be received from plants of any type, of any size, in any service, in which a modernization program was completed during the calendar year 1953 or 1954. Modernization may cover the entire power-service installation or any major part of it.

2. Entries may be made by any responsible member of a plant's power-service staff, or by a consultant for his client.

3. To enter, just say "I'd like a 1955 Modernization Award blank" and address your card or note to:

Modernization Award Committee
c/o POWER
McGraw-Hill Publishing Co, Inc
330 West 42nd Street
New York 36, N. Y.

4. The entry blank you receive will contain a series of streamlined questions designed to make it easy for you to tell us about your modernization job and its results.

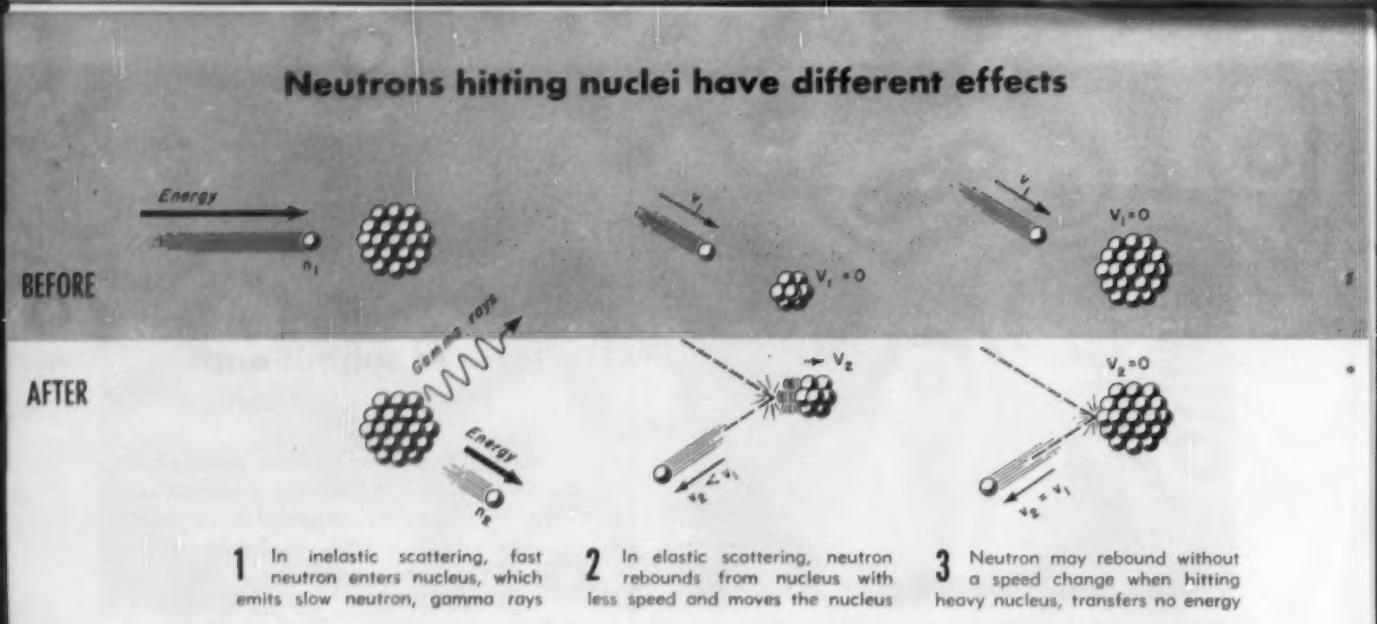
5. In general, the kind of information we ask for will tell us (1) what was modernized (2) the principal reasons for modernization (3) what results were obtained (4) the unique features of the job, and (5) what unusual or difficult problems were solved.

6. Entries will be accepted to May 15, 1955.

7. Announcement of award winners will be made in the 1955 Mid-September *Modern Plant* issue.

8. Arrangements for presentation of the awards will be made to suit the mutual convenience of the recipients and the POWER staff.

9. There is no set number of awards. It is our intention to recognize all plants that, in the opinion of the judges, have carried out modernizations of outstanding merit.


Neutrons hitting nuclei have different effects
BEFORE
AFTER
Energy
Gamma rays
Energy
$V_1 = 0$
$V_2$
$V_2 = 0$
1 In inelastic scattering, fast neutron enters nucleus, which emits slow neutron, gamma rays
2 In elastic scattering, neutron rebounds from nucleus with less speed and moves the nucleus
3 Neutron may rebound without a speed change when hitting heavy nucleus, transfers no energy

**Atomically speaking, nuclei of solid metals hover in a vast open space. Speeding neutrons, protons, etc, have an open road. To hit the nuclei we must know . . .**

# How neutrons behave as bullets

By **HENRY C SCHWENK**, *Henry Pratt Company*
and **ROBERT H SHANNON**, *United Engineers and Constructors, Inc*

► SINCE IT HAS no charge, the neutron can move rather long distances through matter without being stopped. Electrical forces in the atom mean that charged particles, like protons and alpha particles, can only penetrate to nuclei when they have a great deal of energy. This must be kinetic energy, that is, motion. The "potential barrier" formed by the electrical repulsion between positive charges can only be penetrated with the hammer blow of high kinetic energy.

This barrier has no effect on a "slow" neutron, which can enter and react with nuclei of all elements. Fissioning of uranium is the most important reaction because of the energy released. This makes neutrons one of our essential atomic tools.

**Neutron sources.** Let us review methods of producing neutrons:

1. *Alpha-particle reactions* use an alpha emitter, such as radium or polonium, to bombard a light element like beryllium or boron. The original discovery of the neutron used the $(a, n)$ reaction: ${}_4Be^9 + {}_2He^4 \rightarrow {}_6C^{12} + {}_0n^1$.

2. *Photonuclear reactions* $(\gamma, n)$ where gamma rays interact with a nucleus. This transmits enough energy to make the excited nucleus emit a neutron: ${}_4Be^9 + {}_0\gamma^0 \rightarrow {}_4Be^8 + {}_0n^1$.

3. *Particle accelerators*, such as a cyclotron or Van de Graff machine, speed up charged particles to bombard targets of lithium, beryllium, etc. The reactions generate a neutron beam.

4. *Nuclear reactors* use neutrons to produce fission reactions which, in turn, emit high-speed neutrons. For example, fissioning U-235 has the reactions:

${}_0n^1 + {}_{92}U^{235} \rightarrow {}_{92}U^{236}$

${}_{92}U^{236} \rightarrow$ fission fragments $+ 2$ (or 3) ${}_0n^1$

On the average there are 2½ neutrons per fission reaction.

**Neutron reactions.** In Part 5, POWER, Nov 1954, pp 78-80, we studied several types of nuclear reactions resulting from neutron capture. These include:

1. *Radiative capture* $(n, \gamma)$ in which the resulting compound nucleus emits the excess energy as gamma radiation. The product nucleus often is radioactive and decays through beta emission. For example:

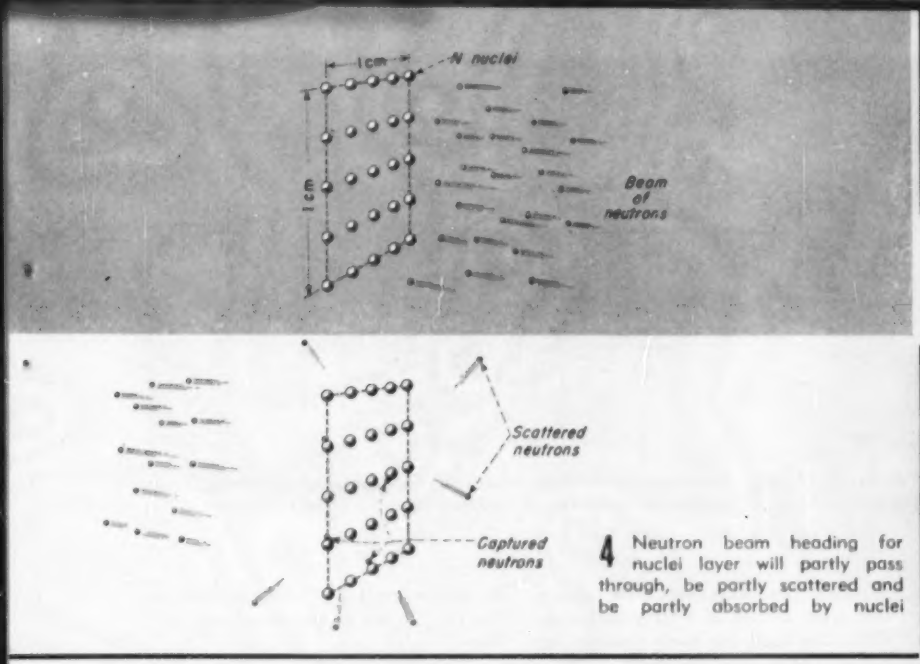
${}_{29}Cu^{63} + {}_0n^1 \rightarrow {}_{29}Cu^{64} + \gamma$

2. *Charged-particle emission*, which produces either a proton or an alpha particle as in:

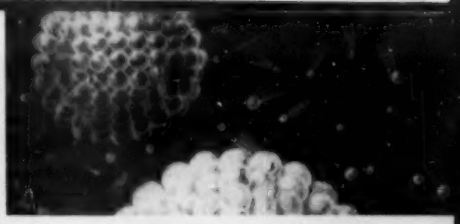
${}_7N^{14} + {}_0n^1 \rightarrow {}_6C^{14} + {}_1H^1$

3. *Fission* of either U-233, U-235 or Pu-239. We gave an example for U-235 above.

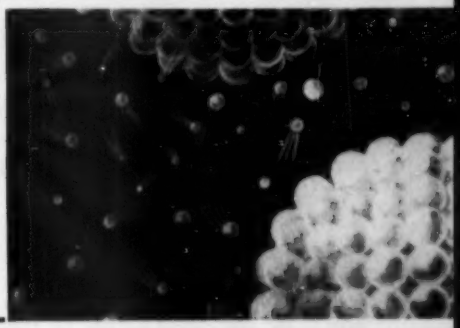
These three reactions are *capture* or




4 Neutron beam heading for nuclei layer will partly pass through, be partly scattered and be partly absorbed by nuclei



**NUCLEAR-ENERGY STUDY COURSE: NUMBER 6**



so-called *absorption* reactions. The target nucleus absorbs the bombarding neutron to form a highly excited "compound" nucleus. In an effort to become stable, this nucleus emits the excess energy as radiation or charged particles, or fissions.

A neutron striking a nucleus, however, can cause a *scattering reaction*. This reaction expels another neutron, a (*n*, *n*) reaction. *Scattering* involves the transfer of energy from one particle to another identical one. There are two types:

(a) *Inelastic scattering* occurs when a neutron enters a target nucleus to form a compound nucleus. The latter emits a neutron with a lower kinetic energy than the entering neutron. The excess energy in the nucleus leaves it in an excited state, and appears as gamma radiation, Fig. 1. A neutron must have a relatively large amount of energy, at least 0.1 million electron volts (mev), to produce inelastic scattering.

In reactors the neutrons, released by fissioning, initially have high energies, in the mev range. Inelastic scattering occurs to some extent as the neutrons move through the reactor. However, most neutron speeds (energy) soon drop to a level that makes inelastic scattering impossible.

(b) *Elastic scattering* resembles a "billiard ball" type of collision. The neutron collides with the target nucleus and recoils with less energy (speed) than it had before the collision. The reduction in energy appears as motion of the target nucleus. The amount of energy transferred depends on the angle through which the neutron rebounds, Fig. 2.

There are two limits to elastic scattering. Fig. 3 shows a neutron hitting a very heavy element. The neutron rebounds without loss of speed and without budging the target nucleus. At the other extreme, Fig. 5 shows a neutron striking a very light nucleus. The neutron transfers all its kinetic energy to the target nucleus and comes to a dead stop. It's easy to see that there will be all degrees of energy transfer from a speeding neutron to a target nucleus. This transfer depends on not only the scattering angle (rebound angle) but also the nucleus mass number.

**Moderation.** In a reactor we are concerned with neutrons produced by fission that either maintain a chain reaction or manufacture plutonium. These neutrons have a fairly high kinetic energy (in the mev range) and are called *fast neutrons*. *Slow neutrons* have a better chance than fast of causing nuclear reactions. This may be thought of as the result of a slow neutron spending more time in the vicinity of a nucleus as it passes than does a fast-moving neutron. This greatly increases the probability of a reaction between a nucleus and passing neutron.

To apply this principle we use elastic scattering to remove kinetic energy from fast neutrons and "brake" them to slow neutrons. During a number of collisions with light nuclei, neutron speed drops so the neutron has the same average kinetic energy as the nuclei, Fig. 6. This energy, which depends on the temperature of the nuclei, is called the *thermal energy* range. Neutrons whose energies have been reduced to this level are called *thermal neutrons*. Materials used for elastic scattering are called *moderators*—they moderate the neutron energy level.

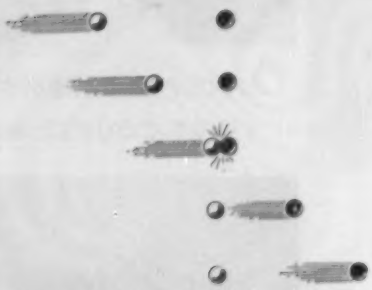
Good moderators reduce fast neutron speeds in a small number of elastic collisions, but do not absorb many neutrons. Atoms of low mass number, such as hydrogen, carbon, beryllium or molecules of light water ($H_2O$) or heavy water ($D_2O$), make good moderators because more energy can be transferred to them per collision than to heavier atoms. The lighter the element, the greater the drop in neutron energy in an elastic collision.

**Measuring neutron events.** To measure the probability of scattering, absorption or fission occurring when a neutron passes through matter, the term *nuclear*

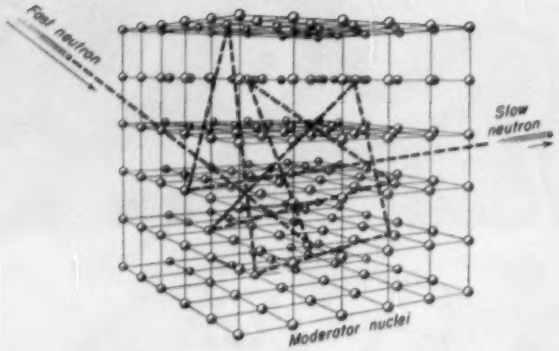
**Cross sections of some elements**

(Thermal neutrons)

| Element or isotope | Cross section, barns | | |
|---|---|---|---|
| | Scattering | Absorption | Fission |
| H | 20 – 80 | 0.33 | — |
| He | 1.55 | 0.008 | — |
| Be | 7 | 0.010 | — |
| B | 4 | 750 | — |
| C | 4.8 | 0.0045 | — |
| O | 4.2 | $0.2 \times 10^{-3}$ | — |
| Ni | 17.5 | 4.5 | — |
| Fe | 11 | 2.5 | — |
| Zr | 8.0 | 0.4 | — |
| Cd | 7 | 2400 | — |
| Pd | 8.3 | 0.2 | — |
| U (natural) | 8.2 | 7.42 | 3.92 |
| U-235 | 8.2 | 650 | 549 |
| U-238 | 8.2 | 2.80 | 0 |
| Pu-239 | — | 1025 | 664 |



5 Neutron may transfer all its energy to target and come to complete stop




6 Fast neutron entering moderator bounces around, hitting nuclei, giving up energy and slowing down at each collision

*cross section* was coined. Chance of a collision between a neutron and nucleus is represented by the *effective target area* of the bombarded nucleus for that particular process. Probability for a reaction is proportional to the cross-sectional area presented by the nucleus. Large nuclear cross sections mean high reaction efficiency, and vice versa.

Fig. 4 shows schematically a beam of neutrons striking a target material during a given period. In one sq cm there actually would be billions of billions of nuclei and millions of neutrons involved. The cross section of this material would be $\sigma$ (sigma) figured by the formula:

$$\sigma = \frac{A}{NI}$$ where

$\sigma$ = cross section, the average effective target area that each individual nucleus presents to the oncoming neutron, sq cm per nucleus

$A$ = number of nuclei actually struck and transmuted

$I$ = number of neutrons entering one sq cm of target material

$N$ = total number of nuclei (or atoms) in the target material, nuclei per sq cm

The fraction $A/I$ measures the proportion of entering neutrons that react with nuclei. Dividing this by the number of nuclei per sq cm gives us the sq cm per nucleus that participates in the reactions, on the average.

**Cross sections.** We have seen that a neutron may be (1) absorbed or (2) scattered. Cross section of a material, then, includes two kinds of events. So we can write: $\sigma = \sigma_s + \sigma_a$
where $\sigma_s$ = scattering cross section; and $\sigma_a$ = absorption cross section.

This gives us a new kind of physical property of any material, just as tensile strength and coefficient of expansion are properties. Cross section of any material going into a reactor is of top importance. For example, if the absorption cross section of a structural material is too high, too many neutrons are lost and chain-reaction efficiency drops.

To be a good moderator, a material must have a large scattering cross section and a small absorption cross section. In other words, the moderator must efficiently reduce speed of neutrons without wastefully absorbing them. This leaves more thermal neutrons to be captured by U-235 nuclei.

The nuclear cross section $\sigma$ is called the *microscopic cross section.* The diameters of nuclei being about $10^{-12}$ cm means that many nuclear projected areas are about $10^{-24}$ sq cm. To keep these numbers from becoming too cumbersome, a unit of cross section called the *barn* has been established. It equals $10^{-24}$ sq cm. A cross section of $2.2 \times 10^{-23}$ sq cm would be written as 22 barns. In terms of nuclear dimensions an area of only $10^{-24}$ sq cm might be "as easy to hit as the broad side of a barn."

Table, p 83, gives some cross section of common elements. This shows that hydrogen, beryllium and carbon are good moderators with low absorption cross sections and high scattering cross sections. Zirconium, iron and nickel might make acceptable reactor structural materials because they tend to scatter rather than absorb neutrons. Boron and cadmium are good control rod materials with high absorption and low scatter. They can absorb neutrons and shut off or control the chain reaction in a reactor. Note the high absorption cross sections of fissionable U-235 and Pu-239 with those of U-238 and natural U.

There is another measure called *macroscopic cross section* related to the volume of the material. It is figured as $\Sigma = N\sigma$ where $N$ is the number of nuclei per cu cm of the material. $\Sigma$ (sigma) measures the total cross section of the nuclei in one cu cm of the material.

**Special cross sections.** A given nucleus generally has different cross sections for each type of neutron reaction in which it can take part. There are separate cross sections for inelastic and elastic scattering for radioactive capture $(n, \gamma)$, proton emission $(n, p)$, alpha-particle emission $(n, \alpha)$, etc. With elements of high atomic number, such as thorium, uranium, and plutonium, there are also fission cross sections.

Not only do cross sections for neutron reactions vary from one isotope to the next of the same element, and change with the nature of the reaction, but they also depend on neutron speed (energy). We haven't the space to study the change of cross section with neutron energy.

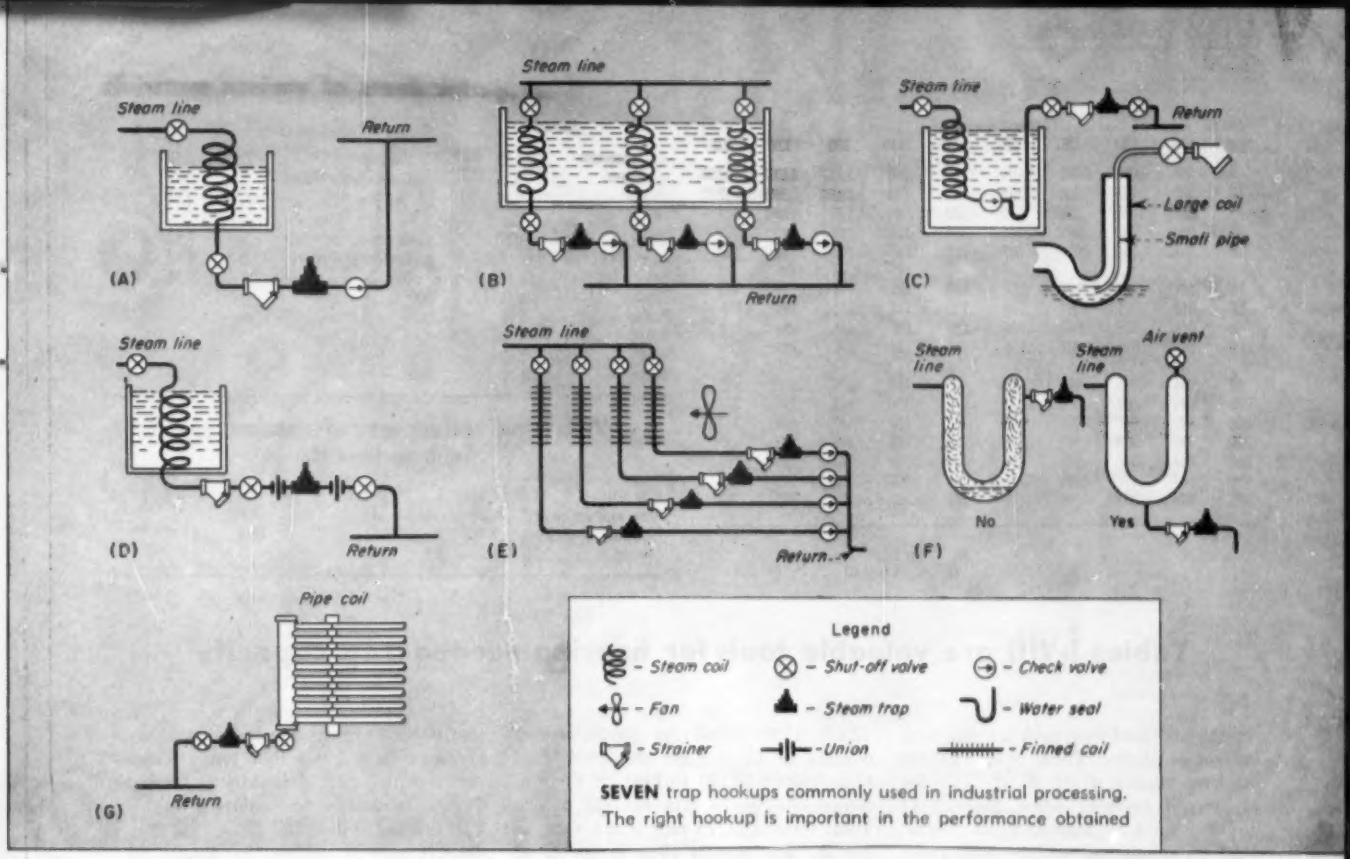
*The next installment will cover nuclear fission and the chain reaction—in a forthcoming issue.*

**Editor's atomic footnotes**

**When we ran** into the unfamiliar Greek letter *sigma*, $\sigma$, in this installment our first impulse was to substitute an English letter. But since this is standard usage in nucleonics, we thought it best to let it stay, and give you the name of the letter in English. This will make reference to standard texts easier for more detailed information.

**We have two** corrections to make: In Part 4, Oct 1954 POWER, p 109, the binding energy equation should read $= 931\ [Zm_p + (A-Z)m_n - M]$. The plus sign was omitted in error.

In Part 5, Nov 1954 POWER, pp 78-80, the nucleus of the heavy hydrogen atom is correctly spelled "deuteron." The second e was omitted.




# For top output, size steam traps right

**The two fundamental considerations in steam-trap selection are trap size and installation hookup for best performance. Detailed examples show you how to obtain these objectives**

By JOHN W WELKER, *Application Engineer, Yarnall-Waring Co*

► THE CAPACITY of a trap does not generally increase in direct proportion to the pressure differential across it. Body and pipe-connection size are not true indicators of trap capacity. Easiest way to confirm these facts is to study the capacity tables published by various manufacturers.

**Condensate loads.** Trap catalogs tabulate condensate-handling capacity at various operating pressures. Calculations to determine condensate loads are required to apply catalog data to specific problems. Safety factors are used to multiply calculated load value before it is compared with trap-capacity table to determine required trap size.

**Load types.** There are three distinct types of load to consider with steam apparatus: (1) start-up (2) normal operation and (3) abnormal operation. During start-up, the apparatus is usually cold and full of air and other noncondensable gases. Because the cold metal must be brought up to temperature, condensate forms at a higher rate than normally, usually resulting in a lower pressure at the trap inlet. This, combined with the abnormal quantity of air to be removed, imposes a heavy load on the trap when the available pressure is at its lowest value.

Condensate formation under normal operation may be essentially constant, or may vary considerably. With constant load, a small factor of safety can be used; if load varies, a larger factor is necessary.

**Load calculation.** When used for heating, steam forms condensate by losing its latent heat in a number of ways, including (1) directly to solid material in pressure vessels—autoclaves, retorts, sterilizers, etc (2) indirectly to a liquid through a metal surface submerged in the liquid—heat exchangers, cooking kettles, etc (3) indirectly to air through bare pipe or tube walls—heating radiators, unit heaters, chamber dryers, etc, and (4) indirectly to solid material through metallic heating surfaces—paper dryers, platen presses, drum dryers, etc.

A different formula determines the

### I: P = (T-t)/L

| Pressure, psig | Temperature rise, F 40 | 60 | 80 | 100 | 120 | 140 | 160 | 180 | 200 |
|---|---|---|---|---|---|---|---|---|---|
| 5 | 0.042 | 0.062 | 0.083 | 0.104 | 0.125 | 0.146 | 0.167 | 0.187 | 0.208 |
| 10 | .042 | .063 | .084 | .105 | .126 | .147 | .168 | .189 | .211 |
| 15 | .042 | .064 | .085 | .106 | .127 | .148 | .169 | .191 | .212 |
| 20 | .043 | .064 | .085 | .106 | .128 | .149 | .170 | .192 | .213 |
| 25 | .043 | .064 | .086 | .107 | .129 | .150 | .172 | .193 | .214 |
| 30 | .043 | .065 | .086 | .108 | .129 | .151 | .172 | .194 | .215 |
| 35 | .043 | .065 | .087 | .108 | .130 | .152 | .173 | .195 | .216 |
| 40 | .044 | .065 | .087 | .109 | .130 | .152 | .174 | .196 | .218 |
| 50 | .044 | .066 | .087 | .110 | .132 | .154 | .176 | .198 | .219 |
| 60 | .044 | .066 | .088 | .111 | .133 | .155 | .177 | .199 | .221 |
| 75 | .045 | .067 | .089 | .112 | .134 | .156 | .179 | .201 | .224 |
| 100 | .045 | .068 | .091 | .114 | .136 | .159 | .182 | .204 | .227 |
| 125 | .046 | .069 | .092 | .115 | .138 | .162 | .184 | .207 | .230 |
| 150 | .047 | .070 | .093 | .117 | .140 | .163 | .187 | .210 | .234 |
| 175 | .047 | .071 | .095 | .118 | .142 | .165 | .189 | .213 | .236 |
| 200 | .048 | .072 | .096 | .120 | .144 | .167 | .191 | .215 | .239 |

### II: Specific heats of various materials

| Solids | | Liquids | |
|---|---|---|---|
| Aluminum | 0.23 | Alcohol | 0.65 |
| Brass | 0.10 | Carbon tetrachloride | 0.20 |
| Copper | 0.10 | Gasoline | 0.53 |
| Glass | 0.20 | Glycerin | 0.58 |
| | | Kerosene | 0.47 |
| Iron | 0.13 | Oils | 0.40 – 0.50 |
| Paper | 0.45 | | |
| Rubber | 0.41 | | |
| Steel | 0.12 | | |
| Sugar | 0.30 | | |
| Wood | 0.45 | | |

### V: External surface area of standard pipe

sq ft per lineal ft

| Pipe size, in. | 1/2 | 3/4 | 1 | 1 1/4 | 1 1/2 | 2 | 2 1/2 | 3 |
|---|---|---|---|---|---|---|---|---|
| Area, sq ft | .22 | .28 | .34 | .44 | .50 | .62 | .75 | .92 |
| Pipe size, in. | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 |
| Area, sq ft | 1.2 | 1.7 | 2.3 | 2.8 | 3.3 | 3.9 | 4.5 | 5.0 |

## Tables I-VIII are valuable tools for figuring needed trap capacity

condensate load for each of the four categories above. These are: (1) for pressure vessels, $C = WSP$ (2a) for submerged surfaces when quantity of liquid heated is known, $C = GwSP$ (2b) for submerged surfaces with quantity heated unknown, $C = KAP$ (3) for pipe coils in air, $C = AR$ (4) for dryers, $C = 970(W-D)/L + WP$.

In these formulas, $C$ = condensate load, lb per unit time; $W$ = weight of material heated, lb; $S$ = specific heat of material heated, see table II; $T-t$ = temperature rise of material heated, deg F; $L$ = latent heat of steam at trap pressure, Btu per lb, see table III; $G$ = gallons of liquid heated per unit time; $w$ = liquid weight, lb per gal; $K$ = over-all coefficient of heat transfer, see table IV; $A$ = heating surface area, sq ft; $H$ = heat loss, Btu per sq ft deg F hr, see table VII; $t_1$ = steam temperature at trap pressure, F; $t_2$ = ambient air temperature, F; $R$ = radiation from heating surface = $H(t_1-t_2)/L$, lb condensate per hr per sq ft, see table VII; $D$ = material weight after drying, lb; $P$ = an arbitrary factor = $(T-t)/L$, see table I.

Four of these equations contain the factor $P$. For convenience this has been calculated and tabulated for various pressures and temperature-rise values, table I.

Formula No. 1. *Example*: Calculate the amount of condensate formed in a canning retort when 2000 lb of fruit is to be processed in 15 min if the insulated steel retort weighs 4000 lb, fruit is processed at 240 F, initial temperature is 60 F and steam pressure is 25 psig.

*Solution*: Using $C = WSP$, $C$ = (2000) (1.0) (0.193) = 386 lb of condensate in 15 min for the fruit. And $C$ = (4000) (0.12) (0.193) = 93 lb of condensate in 15 min for the retort. Total formed in 15 min is the sum, or 479 lb. This equals 1916 lb per hr of condensate. Safety factor allows for the radiation loss.

Formula No. 2a. *Example*: How much condensate forms in the jacket of a kettle when 500 gallons of water are heated from 72 to 212 F by 50-psig steam in 30 min?

*Solution*: Using $C = GwSP$, $C$ = (500) (8.3) (1.0) (0.154) = 639 lb condensate in 30 min, or 1278 lb per hr.

Formula No. 2b. *Example*: How much condensate forms in a coil submerged in an oil heating tank if the coil has a heating surface of 40 sq ft and the oil is heated in the shortest time possible from 60 to 200 F by 25-psig steam?

*Solution*: Using $C = KAP$, $C$ = (100) (40) (0.150) = 600 lb per hr.

Formula No. 3. *Example*: Calculate the amount of condensate formed in 500 ft of 2-in. pipe used to heat a warehouse when steam pressure is 15 psig and air temperature is 60 F.

*Solution*: Using $C = AR$, $C$ = (500) (0.62) (0.56) = 174 lb per hr.

Formula No. 4: *Example*: How much condensate is formed in a chamber dryer when 1000 lb of cereal are dried to 750 lb by 10-psig steam if initial temperature of the cereal is 60 F and final temperature equals that of the steam?

*Solution*: Using $C = 970(W-D)/L + WP$, $C$ = 970(1000-750)/952 + (1000) (0.189) = 444 lb per hr.

**Submerged surfaces.** When heat-exchange equipment has more surface than that needed to heat a specified quantity of liquid in a given time and condensate is withdrawn as rapidly as formed (which is usually desirable), use table VIII instead of formulas 2a and 2b. Condensate rate is determined simply by multiplying the submerged area by an appropriate factor from the table. These data can be used for heating water, chemical solutions, oils and other liquids.

**Heating air.** When air is heated by being blown over steam coils, and the air quantity, the entering and leaving temperatures are known, table VI gives a convenient method of computing condensate load. Without the data required for this table, formula No. 3 and a factor of 5 must be used.

**Trap sizing.** To select a trap whose capacity is determined by any of the above formulas, you have to use a multiplier before referring to a trap-capacity table. These factors, which vary between 2 and 5, are applied to compensate for handling abnormal amounts of air or condensate, variation in steam pressure and unpredictable operating conditions. A factor of 2 is used for pressure vessels, submerged surfaces with gravity discharge, and steam mains. Pipe coils, dryers and submerged surfaces where condensate is lifted to the trap have factors of 3. The factor is 5 for air-blast finned-type heating coils.

Remember, the *exact* condensate load is rarely known, and frequently impossible to calculate. Safety factors also cover inaccuracies in assumptions.

Of course, factors given above may vary slightly from one make of trap to another. So follow catalog recommenda-

(*Continued on page* 198)

## III: Latent heat of steam

| Pressure, psig | Btu per lb | Pressure, psig | Btu per lb |
|---|---|---|---|
| 1 | 968 | 100 | 881 |
| 2 | 965 | 150 | 857 |
| 5 | 961 | 200 | 837 |
| 10 | 952 | 250 | 820 |
| 15 | 945 | 300 | 805 |
| 20 | 940 | 350 | 790 |
| 25 | 934 | 400 | 776 |
| 50 | 912 | 450 | 764 |
| 75 | 895 | 500 | 751 |
| | | 600 | 728 |

## IV: Ordinary ranges of over-all coefficients of heat transfer

(Under many conditions higher or lower values may be realized)

U = Btu/ (hr) (sq ft) ($^0$F)

| Type of heat exchanger | State of controlling resistance: Free convection, U | Forced convection, U | Typical Fluid | Typical apparatus |
|---|---|---|---|---|
| Liquid to liquid | 25– 60 | 150–300 | Water | Liquid-to-liquid heat exchangers |
| Liquid to liquid | 5– 10 | 20– 50 | Oil | |
| Liquid to gas* | 1– 3 | 2– 10 | ..... | Hot-water radiators |
| Liquid to boiling liquid | 20– 60 | 50–150 | Water | Brine coolers |
| Liquid to boiling liquid | 5– 20 | 25– 60 | Oil | |
| Gas* to liquid | 1– 3 | 2– 10 | ..... | Air coolers, economizers |
| Gas* to gas | 0.6– 2 | 2– 6 | ..... | Steam superheaters |
| Gas* to boiling liquid | 1– 3 | 2– 10 | ..... | Steam boilers |
| Condensing vapor to liquid ..... | 50–200 | 150–800 | Steam to water | Liquid heaters and condensers |
| Condensing vapor to liquid ..... | 10– 30 | 20– 60 | Steam to oil | |
| Condensing vapor to liquid ..... | 40– 80 | 60–150 | Organic vapor to water | |
| Condensing vapor to liquid ..... | | 15–300 | Steam-gas mixture | |
| Condensing vapor to gas* ..... | 1– 2 | 2– 10 | ..... | Steam pipes in air, air heaters |
| Condensing vapor to boiling liquid ..... | 40–100 | ..... | ..... | Scale-forming evaporators |
| Condensing vapor to boiling liquid ..... | 300–800 | ..... | Steam to water | |
| Condensing vapor to boiling liquid ..... | 50–150 | ..... | Steam to oil | |

* At atmospheric pressure

## VI: Steam condensed by air

**lb per hr per 1000 cfm***

| Temp diff, F | Pressure, psig: 5 | 10 | 50 | 100 | 150 |
|---|---|---|---|---|---|
| 50 | 61 | 61 | 63 | 66 | 67 |
| 100 | 120 | 122 | 126 | 132 | 134 |
| 150 | 180 | 183 | 189 | 198 | 201 |
| 200 | 240 | 244 | 252 | 264 | 268 |
| 250 | 300 | 305 | 315 | 330 | 335 |
| 300 | 360 | 366 | 378 | 396 | 402 |

*Based on 0.0192 Btu absorbed per cu ft of saturated air per deg F at 32F. For 0 F, multiply by 1.1

## VII: Radiation from bare iron and steel heating surfaces*

| Air temp, F | Steam pressure, psig: 1 | 2 | 5 | 10 | 15 | 20 | 25 | 50 | 75 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 600 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 32 | .53 | .54 | .57 | .70 | .74 | .78 | .81 | 1.02 | 1.13 | 1.30 | 1.46 | 1.70 | 1.86 | 1.97 | 2.31 | 2.41 | 2.52 | 2.62 | 3.14 |
| 50 | .48 | .49 | .52 | .56 | .68 | .71 | .74 | .87 | 1.06 | 1.15 | 1.38 | 1.52 | 1.74 | 1.85 | 1.96 | 2.06 | 2.41 | 2.52 | 2.71 |
| 60 | .45 | .46 | .49 | .53 | .56 | .59 | .71 | .84 | 1.02 | 1.10 | 1.34 | 1.47 | 1.58 | 1.80 | 1.91 | 2.00 | 2.35 | 2.46 | 2.65 |
| 65 | .44 | .45 | .47 | .52 | .55 | .58 | .69 | .82 | 1.00 | 1.08 | 1.32 | 1.45 | 1.56 | 1.77 | 1.88 | 1.97 | 2.07 | 2.43 | 2.62 |
| 70 | .39 | .40 | .45 | .50 | .53 | .56 | .59 | .80 | 0.98 | 1.06 | 1.21 | 1.43 | 1.54 | 1.75 | 1.86 | 1.95 | 2.04 | 2.39 | 2.59 |
| 75 | .38 | .39 | .44 | .49 | .52 | .55 | .58 | .77 | .88 | 1.05 | 1.19 | 1.40 | 1.52 | 1.62 | 1.83 | 1.93 | 2.02 | 2.11 | 2.56 |
| Value of heat loss used (H) | 2.6 | | | 2.8 | | | | 3.2 | | 3.5 | | 3.75 | | | 4.0 | | | 4.5 | 5.0 |

* Based on still air; for forced-air circulation multiply above values by 5

## VIII: Condensate formed in submerged steel heating surfaces*

**lb per hr per sq ft**

| Mtd** | Btu/sq ft/hr | Steam pressure, psig: 1 | 2 | 5 | 10 | 15 | 20 | 25 | 50 | 75 | 100 | 150 | 200 | 250 | 300 | 350 | 400 | 450 | 500 | 600 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 280 | .28 | .29 | .29 | .29 | .30 | .30 | .30 | .31 | .31 | .32 | .33 | .33 | .34 | .35 | .35 | .36 | .37 | .37 | .38 |
| 20 | 930 | .96 | .97 | .97 | .98 | .99 | .99 | 1.00 | 1.02 | 1.04 | 1.05 | 1.08 | 1.11 | 1.14 | 1.16 | 1.18 | 1.20 | 1.22 | 1.24 | 1.28 |
| 30 | 1,900 | 1.96 | 1.97 | 1.98 | 1.99 | 2.01 | 2.02 | 2.03 | 2.08 | 2.12 | 2.16 | 2.22 | 2.27 | 2.32 | 2.36 | 2.41 | 2.45 | 2.49 | 2.53 | 2.61 |
| 40 | 3,100 | 3.20 | 3.21 | 3.23 | 3.26 | 3.28 | 3.30 | 3.32 | 3.40 | 3.46 | 3.52 | 3.62 | 3.72 | 3.78 | 3.85 | 3.92 | 3.99 | 4.06 | 4.13 | 4.25 |
| 50 | 4,500 | 4.65 | 4.66 | 4.68 | 4.73 | 4.76 | 4.78 | 4.82 | 4.93 | 5.02 | 5.11 | 5.25 | 5.38 | 5.48 | 5.58 | 5.69 | 5.80 | 5.89 | 5.99 | 6.17 |
| 60 | 6,250 | 6.45 | 6.47 | 6.51 | 6.57 | 6.62 | 6.65 | 6.69 | 6.86 | 6.97 | 7.10 | 7.30 | 7.47 | 7.62 | 7.76 | 7.92 | 8.06 | 8.18 | 8.33 | 8.58 |
| 70 | 8,000 | 8.26 | 8.29 | 8.33 | 8.41 | 8.46 | 8.52 | 8.57 | 8.77 | 8.93 | 9.08 | 9.34 | 9.56 | 9.75 | 9.94 | 10.15 | 10.32 | 10.47 | 10.65 | 10.97 |
| 80 | 10,400 | 10.73 | 10.77 | 10.83 | 10.93 | 11.00 | 11.06 | 11.13 | 11.40 | 11.61 | 11.80 | 12.14 | 12.43 | 12.67 | 12.92 | 13.17 | 13.40 | 13.62 | 13.85 | 14.26 |
| 90 | 12,500 | 12.90 | 12.95 | 13.00 | 13.13 | 13.23 | 13.30 | 13.37 | 13.70 | 13.95 | 14.20 | 14.60 | 14.94 | 15.24 | 15.53 | 15.83 | 16.13 | 16.36 | 16.65 | 17.15 |
| 100 | 15,000 | 15.47 | 15.55 | 15.62 | 15.75 | 15.86 | 15.95 | 16.05 | 16.44 | 16.75 | 17.03 | 17.50 | 17.90 | 18.28 | 18.63 | 18.97 | 19.34 | 19.64 | 19.97 | 20.57 |
| 125 | 22,400 | 23.10 | 23.20 | 23.30 | 23.53 | 23.70 | 23.85 | 23.95 | 24.55 | 25.10 | 25.45 | 26.15 | 26.75 | 27.30 | 27.80 | 28.35 | 28.90 | 29.30 | 29.85 | 30.73 |
| 150 | 30,000 | 30.95 | 31.10 | 31.20 | 31.50 | 31.70 | 31.90 | 32.10 | 32.90 | 33.50 | 34.10 | 35.20 | 35.85 | 36.60 | 37.30 | 38.00 | 38.70 | 39.30 | 39.95 | 41.15 |
| 175 | 40,000 | 41.30 | 41.50 | 41.65 | 42.00 | 42.30 | 42.60 | 42.80 | 43.80 | 44.30 | 45.40 | 46.70 | 47.80 | 48.75 | 49.70 | 50.65 | 51.60 | 52.40 | 53.30 | 54.85 |
| 200 | 50,000 | 51.60 | 51.80 | 52.10 | 52.50 | 52.85 | 53.20 | 53.50 | 54.80 | 55.80 | 56.75 | 58.30 | 59.70 | 60.90 | 62.10 | 63.30 | 64.50 | 65.50 | 66.60 | 68.60 |
| 250 | 82,000 | 83.70 | 85.00 | 85.30 | 86.20 | 86.70 | 87.25 | 87.75 | 90.00 | 91.60 | 93.10 | 95.70 | 98.00 | 100.00 | 102.00 | 103.70 | 105.70 | 107.30 | 109.30 | 112.50 |
| 300 | 100,000 | 103.30 | 103.60 | 104.00 | 105.00 | 105.70 | 106.30 | 107.00 | 109.50 | 111.60 | 113.50 | 116.60 | 119.40 | 122.00 | 124.20 | 126.50 | 128.80 | 131.00 | 133.30 | 137.00 |

* For copper, multiply table data by 2 For brass, multiply table data ov 1/6

** Mean temperature difference, F – temperature of steam minus average liquid temperature

Heat transfer data for calculating this table obtained from and used by permission of the American Radiator & Standard Sanitary Corp.

# Know your burners and stokers for topnotch plant operation

**Here's how to burn gas, oil, pulverized and solid fuels for best results. The author gives practical tips on fuel characteristics, as well as burner and stoker design, operation**

By D C SWIFT, *Ebasco Services Incorporated*

► WHILE YOUR PLANT EQUIPMENT and the fuels most easily available determine *what* you burn, *how* you burn it is another story. The methods outlined here will help you get started on the right foot, with any of the common burner and stoker designs.

## GAS BURNERS

Burning gas appears simple, but it is actually rather difficult and more dangerous than burning other fuels. Reasons include: (1) little flame luminosity from many types of gas, making it hard to see what's going on in the furnace (2) invisibility of unburned gas accumulations, presenting explosion hazard (3) varying heat content, ranging from 80 Btu per cu ft for blast-furnace gas to about 1000 Btu per cu ft for natural gas to 2000 Btu per cu ft for rich refinery gas (4) varying characteristics of flame-propagation speed and ignition temperature.

Burners aim to mix gas and air intimately and evenly, so gas will be completely burned before it strikes the cold surfaces of boiler or furnace. Temperatures across furnace should be uniform.

**Burner types.** The ring burner is the most common. Gas issues from a number of small holes drilled around the inner periphery of the ring, jetting into a stream of air passing through the center. Damper vanes regulate quantity of entering air, usually giving it a spin to promote turbulence.

You get good mixing if gas pressures are high enough. It takes at least 8-psi gas pressure at full load to insure good burner performance at low load. If piping or gas is dirty, the small burner ports may plug up. Clean and blow gas lines thoroughly before putting burners into service. Also, inspect and clean the nozzles at each boiler outage.

If air flow increases more than 50% above normal gas-air ratio, or if gas pressure falls to less than 0.5 psig, burner is susceptible to loss of ignition. Keep gas-air flow ratio within close limits while making heavy load changes.

Centrally fired burners are arranged so gas issues semi-radially in the center of the burner through a relatively small number of large ports. Air enters through register dampers that regulate quantity and impart a spin to the air, much as in the ring burner. Centrally fired units are more stable when air flow is not accurately proportioned to gas flow because the central gas nozzle tends to shield the flame and the gas jets are much larger. They do not plug up with dirt so readily as on the ring burner, and can be cleaned with boiler in service, if necessary.

The centrally fired burners seem to be more sensitive to air register position and air balance; make careful visual and temperature checks to see that furnace temperatures are even.

Other operating procedures mentioned above for ring burners also apply for centrally fired burners. Required gas pressures are usually a little higher with this burner.

For low-pressure fuel, like coke-oven, sewage or blast-furnace gas, larger ports are required and burners often take the form of a grid with alternating gas and air ports. The larger ports and low pressures make it difficult to get good distribution.

Gas velocity must be held within rather narrow limits, as flame may work back into the port, damaging the burner, if velocity is too low. If it is too high, flame may be unstable, presenting an explosion hazard. Ignition speed must be considered in burner design, particularly with low-pressure gas.

**Lubricate gas cocks** with grease before using, and periodically thereafter. Each boiler inspection is a good time for this job. If cocks are subject to much heat, you may have to change lubrication frequency or grease type.

Inspecting the burner cock vents occasionally indicates whether they are leaking gas. Usual practice is to install two shutoff cocks, a 2-way unit next to the boiler and a 3-way cock with vent connection. Vent relieves space between the two cocks when 3-way cock shuts off gas to burner. Be sure operating levers for both cocks move the same way and to the same position for a given setting.

Design gas piping and air-supply ducts to give balanced distribution to each burner. Amply sized, balanced

burner headers help avoid troubles caused by gas-velocity effects. Deep windboxes and baffle plates or rings shielding the air registers help assure equal air supply to each burner and to the various quadrants of each burner.

Purge supply headers through a vent line to the roof before attempting to light off the first burner. Leave vent open until first burner is lit as the gas flow out of the vent makes it easier to control pressure in the burner header.

Depending on the installation, either (1) establish gas pressure on the header, then open cocks gradually, or (2) open one of the burner cocks first, then build up pressure on the header to the safe minimum value. The second method is usually easier to handle if main control valve is small or if bypass around main valve is small.

**Lighting off.** Before turning gas into the first burner, purge the furnace for at least five minutes with a good flow of air, and place a stable, good-sized ignition torch where it readily ignites the gas. Regulate furnace draft to about 0.3 in. of water, and reduce air flow through the burner to be lighted so flame is not blown out.

If fans are oversize, or damper tightness or fan speed control is poor, divert excess air by partially opening registers of idle burners. Be sure gas cock handles are installed so their position plainly indicates whether cocks are open or closed. Arrange and label so it's easy to see which cock controls which burner.

A few trials and errors establish safe and stable values for gas and air pressures and damper positions for regular lighting-off procedure. If flame is lost, shut off gas promptly. Then repurge furnace thoroughly for three to five minutes with at least 30% maximum air flow, before attempting to relight the burner.

After burner is lit, adjust air-gas flow to give a stable flame, partly blue with yellow tip, that burns out before striking rear wall or boiler tubes. As each subsequent burner is lighted, recheck all burners in operation.

Some pulsation or pressure cycling in gas-burning furnaces appears to be inherent in the fuel; if draft does not fluctuate more than 0.2 in. water, total, this is not too serious. Apparently, degree of mixing of air and fuel, furnace and burner proportions, and general physical arrangement have a considerable effect on pulsation.

## OIL BURNERS

Burners must atomize the oil enough to burn droplets completely before they strike the furnace wall or boiler tubes. To accomplish this, they may use (1) high oil pressure (2) centrifugal action (3) steam (4) heat. Bunker-C or similar heavy oils are usually heated to 200 F, while light oils like No. 2 or 3 may need no heating at all. Heating above 230 or 240 F can cause oil carbonization in the heater tubes and on the burner tips.

**In operation,** oil sprays in a cone shape from a removable nozzle. Air enters through registers or louvers to pass through the oil spray and carry it into the furnace where burning occurs.

You must coordinate a number of variables to obtain best performance. Adjusting the registers, to vary quantity and spin of the air, adjusts the flame shape. Moving the oil nozzle in or out changes degree of air-oil mixing.

Pulling nozzle back too far lets oil spray strike burner throat tile; a carbon deposit builds up, which further interferes with the oil spray. An air diffuser placed on the burner barrel often stabilizes the flame. Its effect, plus the oil spray, may restrict air-flow quantity.

On the other hand, moving nozzle too far into the furnace lets air bypass the oil spray causing long, smoky flames. Orifice size and shape of the entrance and leaving ports have considerable effect on flame shape. Oil pressure, and for wide-range burners, the differential pressure, is also important. In general, you need at least 100 psi at orifice inlet to get good atomization without steam.

Before putting burner into service, clean, assemble properly, and tighten it. A dirty or leaky nozzle may permit a pool of oil to form, resulting in destructive fire in windbox or on furnace floor, heavy concentration of fire on waterwall or refractory surface.

Also, avoid heavy flame impingement on floor screen tubes. Steam bubbles rising to the tops of the nearly horizontal tubes restrict cooling of these heavily heated surfaces.

When cutting a burner out of service, shut off the oil, then blow out thoroughly with compressed air or steam to remove all oil remaining in burner barrel and nozzle. Remove barrel and tip assemblies when not in use. After cleaning, reassemble and hang vertically with tips immersed in kerosene or light oil.

If you must cut burners in and out of service frequently, you may want to keep nozzles in place. Blow out after using, then withdraw nozzle as far as possible to protect it from furnace heat. Insert and reposition burner tube and nozzle just before lighting off again.

If you use steam atomization, put check valves in the steam line to each burner. This prevents forcing oil back through the steam lines and into the boiler, where it could cause rapid tube failure.

Arrange piping to permit hot oil circulation right up to burner shutoff valves. Then burners can start working properly with heated, correct viscosity oil at the earliest possible moment, avoiding unburned oil accumulations in the furnace. Provide means for observing oil temperature and pressure to and from burners.

**Lighting off.** Use an oil-soaked asbestos-wicking torch rod or an electric spark-ignition system for lighting off each burner. Air flow through the burner being lighted should be low until ignition is established. Then adjust oil-air ratio to eliminate heavy smoke or excessively long flames.

Too much air may cause "sparklers," and smoke issuing from stack may have a blue or gray appearance. If flaming-oil droplets spray out onto walls or furnace floor, atomization is incomplete.

You will often find it helpful to recirculate oil back to the tank or heater to avoid an excessive pressure drop as flow into the burner is established. Continue recirculation until two or three burners are lighted. Check all burners as each one is lighted off.

## PULVERIZED COAL BURNERS

Arrangement of burners depends on fuel plus furnace size and shape. In general, the coal must be finely ground so 70 to 80% passes through a 200-mesh screen. The lower the volatile content, the finer the pulverization needed to offset the lower ignition rate.

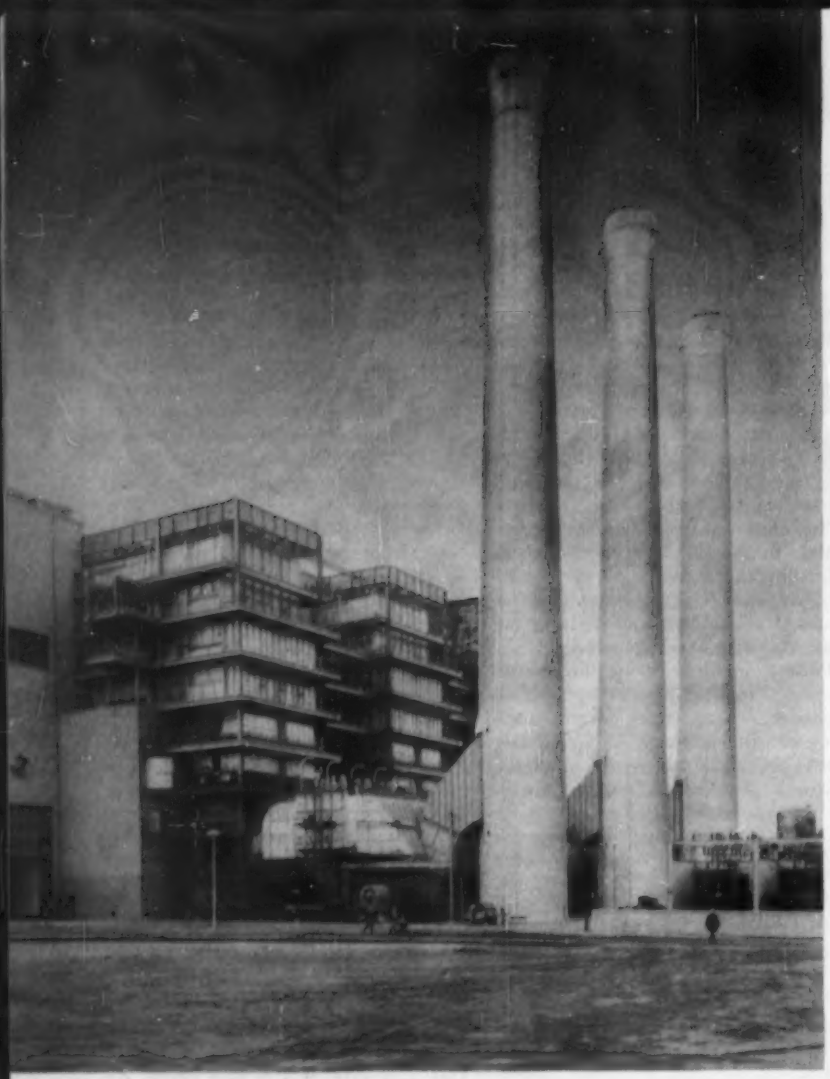
Some 10 to 20% of the total air required is used to blow in the fuel. With too little primary air, fuel may settle out in burners or pipes. Subsequent re-ignition and damage to burner parts may result. Too much primary air may make the flame unstable.

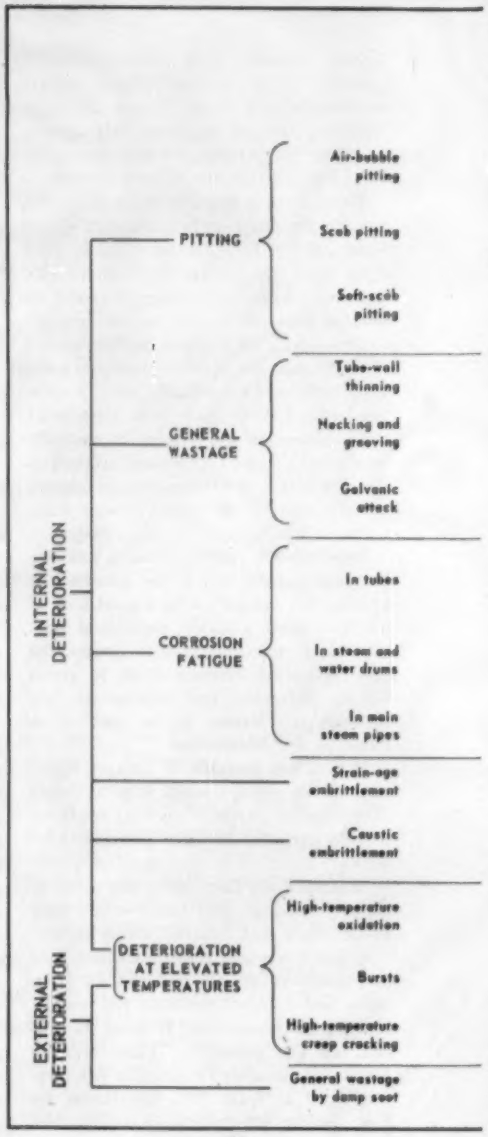
Other factors affecting flame stability include size and shape of (1) burner nozzles (2) distributors (3) coal-air piping and (4) furnace temperature.

**Burner types.** Fish-tail, horizontal-turbulent and corner-fired tangential burners are the three main types for pulverized coal.

Ordinarily, fish-tail burners are installed in an arch near top of furnace. A relatively small amount of primary air carries the coal. Secondary air comes in between the coal primary-air streams. Tertiary air may be admitted

(*Continued on page* 190)






# Guard your h-p boilers against these forms of corrosion

**Recent trend to high-pressure boilers brings some corrosion problems not found in low-pressure units. Improper feedwater treatment, boiler design or operation can cause the trouble**

## FORMS OF BOILER DETERIORATION

| Appearance of corrosion | Usual location | Cause |
|---|---|---|
| Isolated hemispherical pits, often covered with cap of loose, soft corrosion products which, when dry, consist of black iron oxide covered with membrane of red dehydrated ferric hydroxide | Mainly on roof of steam and water drums, but likely to be found on any surfaces in contact with water, where air bubbles might collect. | Liberated air bubbles attach themselves to metal surfaces where they initiate anodic attack by generating localized electrolytic action |
| Deep, localized pitting covered with scab of hard, scaly, black magnetic iron oxide. Scab cannot be removed by wire brushing | Hotter areas of heating surfaces where corrosion products form and rapidly consolidate into hard scab by heat. This is possibly main form of decay encountered | Use of untreated, impure boiler water containing dissolved salts and gas in comparatively small concentrations so that pH lies between 4.8 and 9.4 |
| Broad, shallow pitting capped with fairly hard corrosion products: usually black magnetic iron oxide with layer of red dehydrated ferric hydroxide | In superheater tubes and headers and main steam lines | Deposit of salts by priming in superheaters, main steam lines, etc, followed by condensation on shutdown, results in formation of droplets of electrolyte and initiation of pitting by differential aeration |
| General reduction in thickness of tube wall over rather large areas, often without presence of blankets of corrosion products | Fairly even distribution over water surfaces with tendency to be more pronounced in hotter areas | Use of acid feedwater |
| Circumferential band of corrosion on waterside of fire tubes, stay tubes and stay bolts in Scotch boilers | Where stay bolts, stay tubes and fire tubes enter end plates or combustion chambers | Influence of adjacent end plates on expansion and contraction. Result is stresses that cause repeated localized flaking of protective films |
| Local reduction in metal thickness | Near non-ferrous boiler mountings, in areas of non-homogeneity of steel composition or at breaks in surface films | Use of unlike metals in contact (or at areas of non-uniformity on metal surfaces) in presence of electrolyte. Result is sacrificial attack at anode |
| Network or series of cracks over waterside of tube surfaces | In boiler and superheater tubes on hottest side of bores. Most frequently found in inherently curved tubes or those buckled in service | Irregular circulation causes frequencies of alternate overheating and cooling. This induces pulsating thermal-fatigue stresses in walls. Residual stresses and corrosive environment speed cracking |
| Fissures, usually difficult to detect owing to covering layers of corrosion products; usually associated with deep pitting | Starting at arboring in tube plates, extending axially and eventually joining two or more holes | Bending stresses resulting from lack of common neutral axis between tube and wrapper plate; excessive cold working resulting from initial rough machining. Speeded by thermal stress and corrosive environment |
| Lines of cracks on bores of pipes | On bores of main steam pipes, especially in base of corrugations | Bending stresses resulting from movement during operation in presence of corrosive environment |
| Spontaneous cracking in boiler components during retubing or cleaning operations | Between holes in tube plate, under rivet heads, around top end of tubes adjacent to rolling surfaces | Cold work and aging combine to reduce impact properties. Spontaneous failure occurs only at or below room temp |
| Fissures in boiler plates, etc | In boiler plates, radiating from and often connecting adjacent rivet holes, joints, arborings, etc | Joint effect of non-uniform stressing combined with high concentration of caustic soda in presence of a catalyst at high temperatures |
| Continuous layers of hard black magnetic iron oxide scale | Internal: in fire row and superheater tubes; in drums and headers. External: on surfaces in contact with furnace gas | Internal: poor circulation causes overheating in steam atmosphere. External: local flame impingement, poor circulation or presence of heat-insulating scale on water side |
| Longitudinal gaping split that may or may not be associated with ballooning | Hottest side of generator or superheater tubes | Water starvation results in overheating with corresponding reduction in mechanical properties until tube bursts under working pressure |
| Cracking and splitting associated with layers of high-temperature oxide scale on tube surfaces | In superheater tubes | Stress resulting from restricted expansion combined with overheating at temperatures around 950 C |
| Localized wasting of boiler metal; can be seen only after removal of soot deposits | Wherever soot collects, especially where tubes enter lower drums and headers | Sulfuric acid formed by action of moisture (when shut down) on oxides of sulfur present in oil-fuel soot |

► CORROSION can take many different forms in high-pressure boilers. To find the cause and to arrive at a solution you should: (1) Know something about the mechanism of various types of corrosion. (2) Have complete knowledge of the operating conditions and how they can bring about corrosion.

Unfortunately, this is not always easy. Corrosion may result from so many different conditions that definite classification is sometimes difficult. Table* above lists and breaks down some of the types present in boilers. Although data were made up for marine practice, they apply to like attacks in stationary boilers.

High temperatures present in high-pressure boilers are favorable to corrosion. But attack does not occur with proper feedwater treatment and no deficiencies in boiler design or operation.

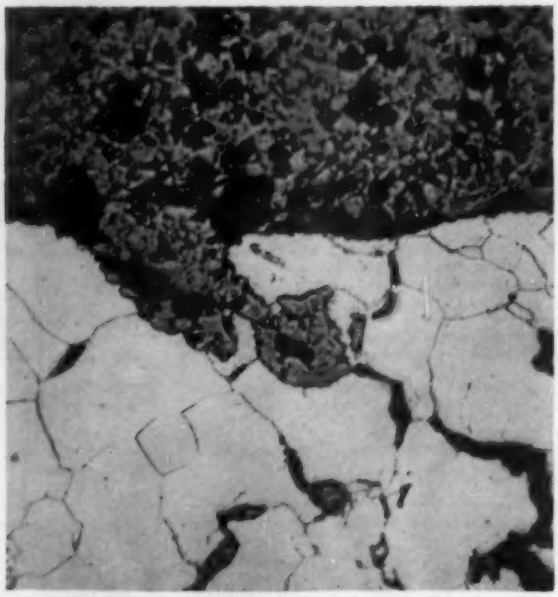
**High metal temperature.** Action of steam on hot iron is an old and well-established method of producing hydrogen commercially. In large-scale operations, temperature is kept at 1200 F or above, as production is relatively slow below this point.

Lately, this dissociation reaction has received much attention in connection with high-temperature high-pressure boiler operation. Below 750 F there seems little cause for fear. Above it the reaction takes on some significance. And one series of tests showed that stagnant steam at atmospheric pressure in contact with heated boiler tubes produced hydrogen with increasing rapidity above 930 F. Reaction was much slower below this temperature.

Ferrous alloys containing high percentages of chromium alone or of chromium and nickel have been found corrosion resistant in steam up to 1100 F. Nonferrous alloys with high percentages of nickel and chromium, on the other hand, have corroded under tests at 925 and 1100 F. Corrosion

*From paper by Slater, J G, and Parr, N L, *Marine Boiler Deterioration*, Proc Institution of Mechanical Engineers, London, Vol 160, p 341, 1949.

**CORRODED** boiler tube section. Active attack under black iron oxide due to inadequate water treatment, faulty circulation



**PHOTOMICROGRAPH** of tube, *left*, shows large intercrystalline crack, several smaller ones, complete decarburization

## Dissociation of high-temperature steam is big item in h-p boiler corrosion

rates of carbon steel against medium- or low-alloy steels differ sharply at 1100 F and scarcely at all at 925 F. The weight loss of plain carbon steel exposed to 1100-F steam continues at a high rate indefinitely whereas the alloyed metals have a rate that decreases with time. Formation and maintenance of an adherent scale always increases corrosion resistance.

Stress, fortunately, seems to have no influence on corrosion rates of steel exposed to high-temperature steam.

**High-temperature creep cracks** make things ripe for corrosion. It's not a common boiler complaint, but there are some cases on record. In one under heavy overload, tube failures developed. Defective circulation had caused overheating.

Photomicrographs of the damaged metal showed narrow bands indicating an intermittent action of short duration. Nature of the metal damages indicated steam blanketing at a point of critical circulation or high heat input, or both.

The metal grain structure showed no evidence of recrystallization, which will take place under a critical strain when temperature is sufficiently high. But temperature was high enough to cause spheroidization. All this means that tube temperature during the intermittent overheating period ran under 1200 F and more likely between 950 and 1100 F.

Problem was corrected by redesigning to give positive circulation under all operating conditions.

**Intergranular disintegration** has been reported in several boilers having water temperatures from 540 to 685 F. These temperatures correspond to operating pressures from 950 to 2800 psig. As far as is known, this particular corrosion does not occur below these pressures.

Metallic copper, oxides of copper and black oxide of iron show up in the affected area. Under these deposits, large corrosion pits form. Beneath these, serious metal deterioration takes place in the form of intergranular disintegration. Copper comes from corrosion of copper-alloy condensers and other heat-exchanger tubes. Ammonia and carbon dioxide in the condensate speed up this action.

Action of high-temperature steam on iron forms black magnetic iron oxide, $Fe_3O_4$, and ionic hydrogen. Oxide film protects the metal, but this barrier may be destroyed by hydrogen or caustic soda. Dissolved oxygen creates pits filled with black oxide, but does not produce hydrogen. Any copper present, though, may form an anodic connection beneath the black oxide so the metal corrodes and releases atomic hydrogen. This gas penetrates the steel to cause decarburation and intergranular disintegration.

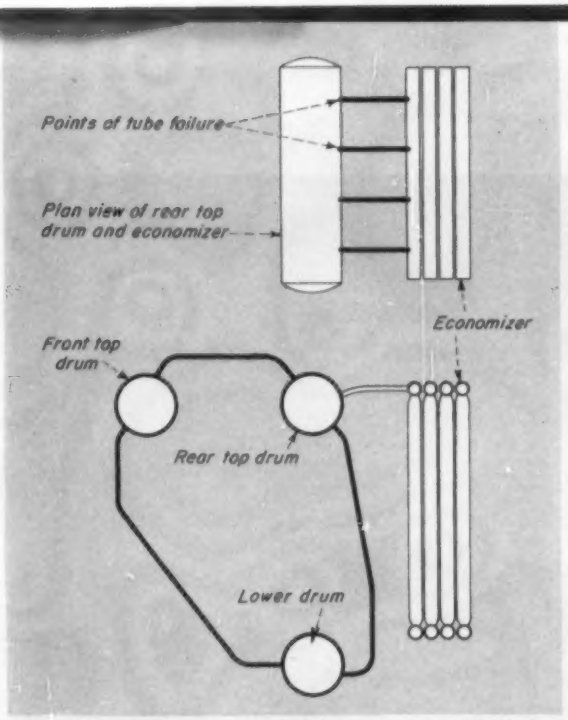
Illustration, top left, shows the effect of this type of attack. The photomicrograph, right, brings out extent of the damage.

Some authorities feel that copper and oxygen are the principal agents in this type of metal damage.

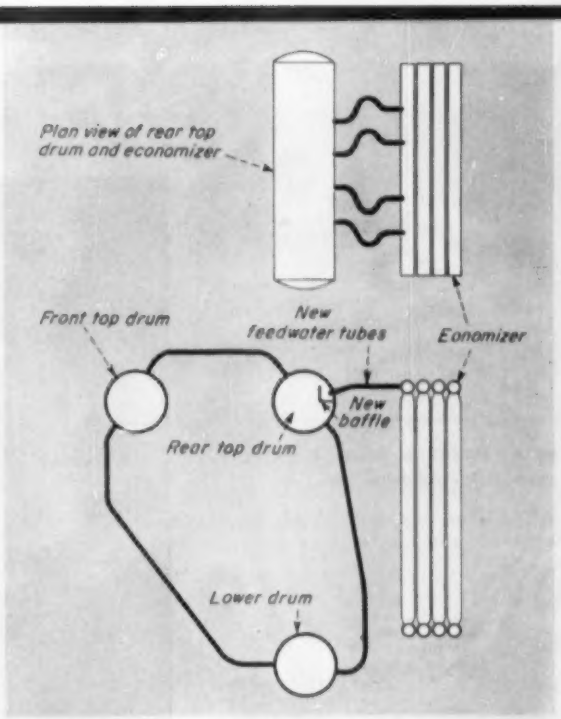
**"Corrosion embrittlement"** is the term employed here to mean boiler-tube failure from corrosion beneath adherent black oxide accompanied by embrittlement of adjacent steel. It results from overheating or sluggish circulation giving metal temperatures not great enough to overheat but high enough to cause film boiling.

In film boiling the water dissociates and the metal combines with oxygen. Magnetic iron oxide forms on the metal surface and hydrogen is released. The tube wall wastes away under this action, resulting in reduction of cross section. The hydrogen penetrates the thin steel along crystallographic planes or grain boundaries and reacts with oxides, nitrides and carbides to form gaseous products within the metal. These products develop tremendous pressures and rupture metal at grain boundaries.

If action proceeds sufficiently, the




**SECTIONAL VIEWS** of watertube boiler and economizer showing location of tube failures caused by corrosion fatigue




**PUTTING A BEND** in the feedwater tubes and installing a new baffle in steam drum stopped corrosion-fatigue tube failures

weakened and embrittled sections fail. High-pressure steam and water may blow these sections out of the tube walls.

In such failures oxygen or copper may be present. But the same failure can take place without either, just with the black oxide film. Copper may, when well bonded to the metal, accelerate rate of corrosion and hydrogen embrittlement. It is interesting, too, that in all cases investigated by the author, metal has never been overheated to the point where this factor alone could be responsible.

Occasionally the black oxide forms in the boiler from dissolved oxygen in the feedwater. Sometimes the oxide comes from products of corrosion carried into the boiler by feedwater. When allowed to accumulate, magnetic oxides compact and adhere on the protective black oxide film. Once the bonding is established, the protective film is penetrated. According to Richard C Corey's diffusion theory, steam and water can come in contact with the steel under the penetrated black oxide film, allowing corrosion embrittlement to proceed.

This type of attack has been corrected by completely removing dissolved oxygen from the feedwater and limiting the formation and accumulation of copper and iron oxides in the boiler. In some cases, boilers were redesigned to improve circulation and eliminate overheating. Water conditioning, both internal and external, controls dissolved oxygen, deposits, volume of iron and copper oxides, pH, and it can be used to provide a fluid sludge.

**Corrosion fatigue** is another form of attack. Here alternating stresses are set up by vibration or other periodic mechanical or thermal changes causing transcrystalline cracks to develop. When corrosion accompanies metal fatigue, attack develops along a stress concentration at the surface of the metal. It ultimately penetrates the metal. This class of failure occurs mostly in locomotive boilers and only rarely in stationary units.

Illustrations above show one such stationary boiler that experienced this trouble. Feedwater originally entered a trough in the boiler drum and then flooded over. But the trough was pulled out to make room for steam-purifying equipment. A feedwater regulator admitted water intermittently according to steam demand.

Feedwater from the economizer to the drum was 300 F. This cold water hit the drum metal, normally at 503 F, many times a day. The straight feedwater tubes, rolled into the drum, had high stresses set up at the rolled-in section of the metal to begin with. And the thermal shock on top of this proved too much. Corrosion fatigue resulted.

To correct the troubles, the feedwater trough was put back in the drum and straight tubes were replaced with S-shaped ones to allow for expansion of these rolled-in tubes. See illustration at top, right.

**Corrosion detection.** Recent data and the present tendency toward higher pressures and temperatures in steam boilers indicate that routine tests for noncondensable gas in water and steam are called for. A recorder for determining hydrogen concentration in the steam is an effective means for detecting the rate of attack that may be going on in the boiler.

The Cambridge Hydrogen Recorder, a device for measuring hydrogen in parts per billion or parts per million, gives a continuous record of the gas in the steam. With it, definite correlations can be made with operating conditions and comparisons can be made with satisfactorily operating boilers of good design.

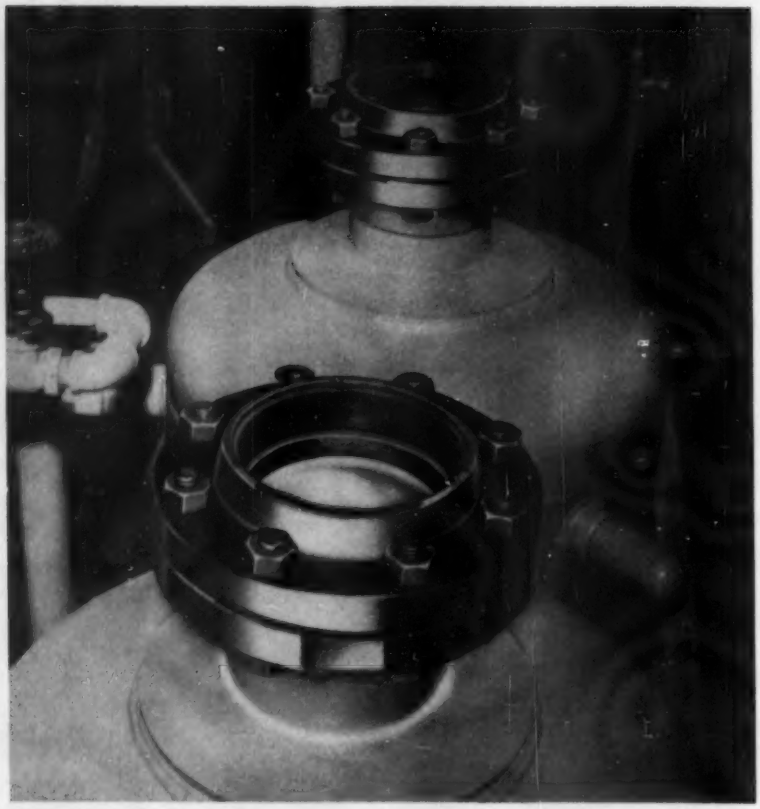
In one investigation, it was found that boiler tubes frequently accumulated heavy iron oxide. The recorder helped by showing excessive hydrogen in the steam, indicating attack on the wall tubes. As soon as this condition was noted, the boiler was taken out of service and the tubes were cleaned.

To properly evaluate hydrogen recorder readings, a measurement of the hydrogen in the feedwater must be taken as a measurable amount of dissolved hydrogen may be present.

If the sampling nozzle delivering saturated steam is located properly, the hydrogen recorder detects fast hydrogen increases when corrosive attack begins.

Part I of a series

By J F MYERS, *Manager, Safety-Head Div, Black, Sivalls and Bryson, Inc*



**SAFETY HEADS** protecting two starting-air bottles in internal-combustion engine plant. These prebulged-type disks have a specific crown height, angular seating

# How to select and apply safety heads

**Purposely designed as the 'weak spot' in a pressure system, the safety head is today being applied more widely than ever throughout industry. Here are basic facts on types and uses**

► PROTECTING SYSTEMS, composed of piping and pressure vessels, against sudden and unexpected pressure increases is not always a simple problem. We may believe our equipment has adequate relief protection, but have we considered the unknown—the pressure we may never expect? This unknown may result from loss of proper control, mechanical failure, ignition, etc.

**Pressures.** Since the trend is toward higher pressures in reaction vessels throughout industry, we must be more conscious of the hazards they involve. And we must also be better prepared to find the best way to relieve abnormal pressures before they exceed the system's safe limit.

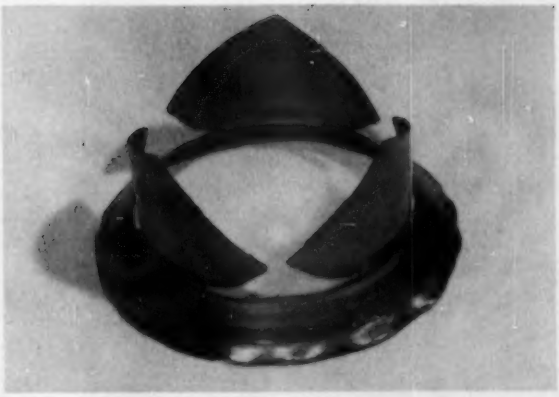
We will exclude from this series the use of rupture disks* on closed pressure vessels where ignition of the contents may produce instantaneous pressures or those within the explosive range. Not enough test data have been developed to cover this subject satisfactorily. But since a rupture disk gives unrestricted passage after operation, it is usually considered the most desirable type of relief device for these conditions.

**Types.** Rupture disks are classified as shear, scored, flat or prebulged. Long experience shows that for uninterrupted service during normal operation of a pressure system, as well as for rupturing within a 5% plus or minus range of the marked rating, a prebulged disk designed for this range is most desirable.

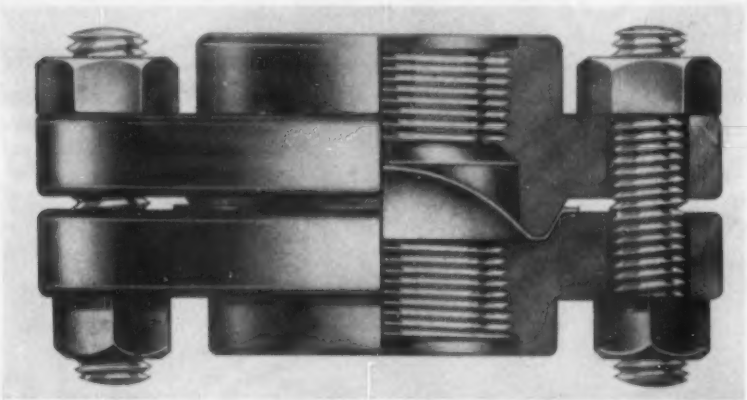
Tests indicate that a flat rupture membrane, taking a prebulged shape when subjected to positive pressure,

*The recommended spelling *disk* is used throughout this article instead of *disc*. The author's firm uses *disk* to denote a flat plate, *disc* to denote a prebulged member. That distinction is not used in this article.

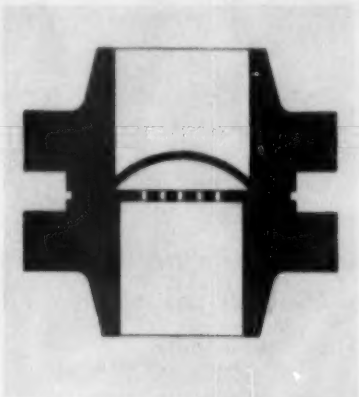
1 Monel 4-in.-diameter prebulged rupture disk is rated for a bursting pressure of 600 psi at a temperature of 72 F



2 In the scored-type prebulged rupture disk the fragments adhere as shown here after operation from excess pressure



3 Prebulged rupture disk has an angular-type flange seating arrangement and a specific crown height for the pressure and temperature conditions encountered



4 Failure to prestress a rupture disk for vacuum use leads to this shape

# for protection of pressure systems

has fatigue characteristics not met in a prebulged disk fabricated to a specific crown height and used with flanges having the angular type of seating arrangement, Fig. 3.

When a flat metal disk is mated between companion flanges, the disk metal may have a tendency to work-harden because it is operating within its elastic limit. Also, stresses may be encountered at the point of flange contact with the disk metal. These are accelerated as disk height increases. As a result, the disk fails from shear or fatigue at a pressure lower than would be expected for the metal thickness used.

Our tests show that temperature limitations must be placed on all metals used in manufacturing prebulged rupture disks to retard creep of metal at normal operating pressure. For this reason temperature affects to a much greater degree a flat metal disk, continually worked below its elastic limit, than a design like that in Fig. 1.

**Disk differential.** It is important to have the normal operating pressure of a closed system at least 50% below the predetermined pressure rating of the prebulged disk. This difference is based on so-called ideal conditions—a static pressure at ambient temperature.

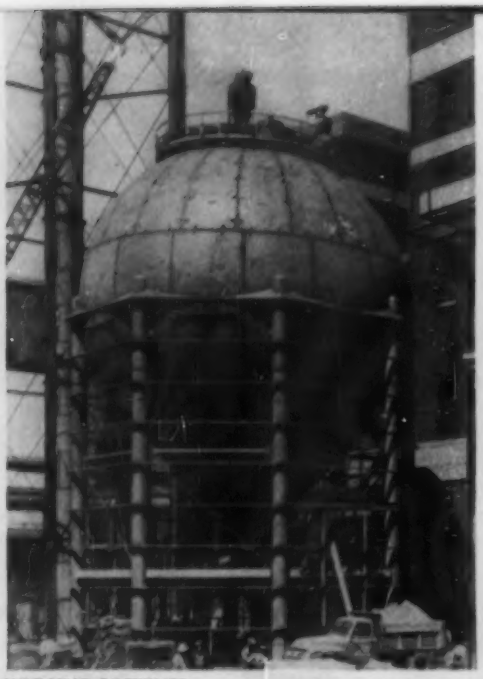
When the disk is subjected to gaseous or liquid pulsations, or to temperature higher than 125 F, it is desirable to increase the differential to 75 or 100%. But it is not always possible to maintain these differentials because of design limitations on the equipment protected by the rupture disk.

**Alternating pressure.** Vacuum service presents an additional problem, when the disk is not formed to a definite contour. A prebulged rupture disk, having a predetermined crown height, is equipped with a vacuum support. Height of support corresponds to that of the disk, restricting its movement when a backpressure is encountered.

This arrangement cannot be satisfactorily achieved when a metal disk is subjected to a positive pressure without being prestressed to a predetermined height. Otherwise, a condition like that in Fig. 4 would be encountered, defeating the purpose of the vacuum support plate. Frequent maintenance can be expected with flat-type disks.

**Scored type,** Fig. 2, is limited to sys-

(*Continued on page* 204)



**HOT-LIME SOFTENER,** spheridome design, during construction. This single unit has 200,000-gph capacity

**ANTHRACITE FILTERS** are operated manually with valve-nest controls. Nine units handle 1,600,000 lb per hr. Turbidity is less than 5 ppm

**Before installing new water-treating facilities, engineers studied all possible types to meet their particular needs. They found that . . .**

# Hot-lime zeolite will save $49,000 yearly at Ford's Rouge Power plant


Third of a series by

**L F O'REILLY,** *Project Engineer*
*Ford Motor Company*

**A K SUKUMAR,** *Mechanical Engineer*
*Ford Motor Company*

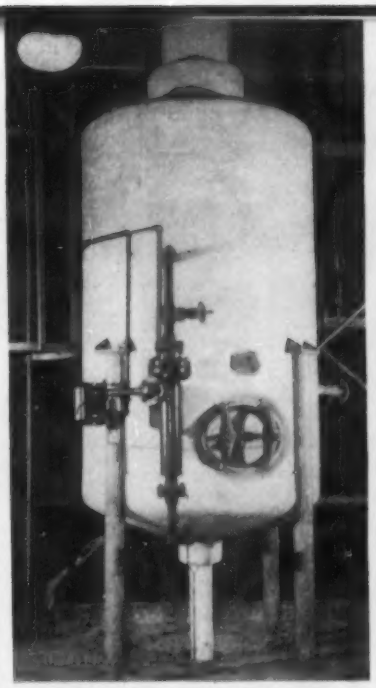
**W J FADDEN JR,** *Chief Mechanical Engineer*
*The Kuljian Corporation*


► WHILE effective water treatment is basic to *any* power-service system, it gets special attention in industrial power plants where high makeup rates prevail —usually because of contaminated condensate from the process or because of need to install long return lines from remote areas. Ford's Rouge Power Plant, largest industrial powerhouse in the world, as measured by steaming capacity, is now modernizing its water-treatment facilities. And in this final of three articles (see POWER, Sept, Nov '54) Ford and Kuljian engineers tell about the engineering and economics of the new system.

**Old arrangement.** Rouge Power Plant installed an evaporator system in 1920, rated at 120,000 lb per hr total, to supply distilled-water makeup to eight 200,000-lb-per-hr boilers. Expansion of facilities in 1926 led to enlargement of this system. Addition of two hot-lime-soda process softeners in 1935, 530,000-lb-per-hr total capacity, reduced a severe evaporator maintenance problem. The year 1945 saw complete removal of some evaporators and the remainder placed in standby service.

**Study of requirements** for an efficient, up-to-date water-treatment system included these factors: (1) New low-pressure steam generators use economizers to boost efficiency. To avoid scale deposits, economizers and boilers need feedwater of less than 5-ppm hardness. Old conditioning system yields feedwater of 15-ppm average hardness.

(2) Raw water from Detroit River (mill water) contains the following dis-



**FLASH TANK** for boiler blowdown. Heat recovered amounts to $30,500 a year

**BACKWASH PUMP** cleans dirty filters. Wash water is from the hot-lime softener

solved chemicals in addition to organic matter and dissolved gases:

| | *Ppm* |
|---|---|
| Total hardness, expressed as $CaCO_3$ | 100 |
| Calcium hardness | 70 |
| Magnesium hardness | 30 |
| Sodium | 7 |
| Methyl orange alkalinity | 76 |
| Sulfates | 20 |
| Chlorides | 11 |
| Silica as $SiO_2$ | 5-6 |

(3) To confirm Ford engineers' judgment, Hall Laboratories ran a series of tests in September 1952. Results showed corrosion in some condensate-return lines in excess of acceptable rates. (4) Because occasional mineral-oil contamination in condensate returns blisters boiler tubes, large amounts of such condensate are rejected to waste until source of such trouble is found and eliminated. During these periods city-water use is greatly increased. This raises feedwater hardness to a level where scale deposits are serious. (5) In winter, when space-heating load is heaviest, feedwater is made up of returned condensate, city water and mill water, totaling 1,600,000 lb per hr. (6) Plan for new system includes feedwater makeup needs of 1400-psi boilers as well as the new 250-psi units. High-quality feedwater must be available even when contamination of mill-water supply or condensate returns by oil or sodium chloride bars their use.

**Hot-lime zeolite savings.** Ford and Kuljian engineers estimate the following advantages and savings will accrue as a result of this treating system: Hot-lime-zeolite system removes oil, organic matter and solids incidentally in the softening process. Mill water will, therefore, be used exclusively—at a saving of about 7.5c per 1000 gallons, compared to city water. This now amounts to $960 per year. In emergencies, when mill water is unusable, city water can also be treated and used.

Old operation does not recover heat from boiler or evaporator blowdown water. New equipment will do this job at a $30,500 annual saving.

Higher-purity feedwater will reduce expense for acid cleaning of boiler tubes, evaporators and associated equipment by $4800 annually. Boiler tubes now get acid cleaning every two years. Purer water will extend this period to four or five years.

The hot-lime-zeolite system reduces treated water hardness to 0-2 ppm as compared to 20 ppm attained with hot-lime-soda process. And the total cost, including internal phosphate treatment, cuts back from 5.03c for the lime-soda-phosphate, to 2.45c for the lime-zeolite-phosphate, per 1000 gallons of treated water. Result: Additional annual savings of $12,740 in chemical costs.

Total savings attributable to water-treatment modernization amount to $49,000 per year.

**Oil separation.** To keep costs down, plans call for condensate return to the hot-lime softener where it will mix intimately with mill-water feed, see flow diagram, p 98. Elaborate oil-separating equipment with its resultant high operating and maintenance cost is thereby eliminated. Oil removal by sludge in the softener sedimentation tank is considered good practice, as long as oil content doesn't exceed *8 ppm.* Oil in combined mill-water makeup and condensate returns rarely exceeds *3 ppm.*

Because the trend not to return condensate from distant buildings is increasing and future developments may possibly dictate no re-use of condensate, a softener capable of producing total feedwater needs from mill water was selected. Much of the plant condensate piping is about 20 years old and will require replacing periodically. This will be done only where it is economical to return the condensate.

**Hot-lime softener.** Photo, facing page, shows the new 200,000-gph unit with spheridome top and conical bottom. Water flows upward in an internal inverted cone, and discharges from its top. This conventional-type design was picked because of oil contamination in condensate returns. Outlet elevation allows gravity flow through filters.

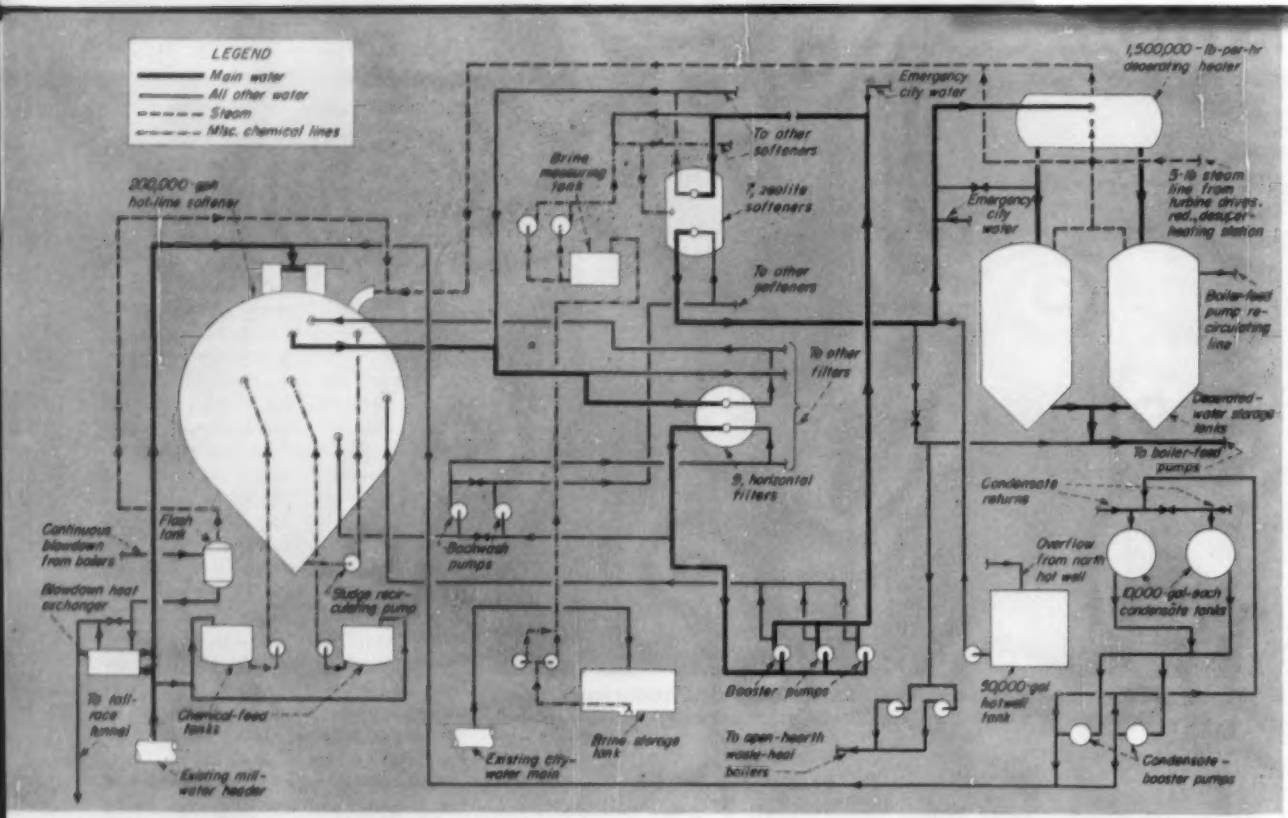
Galbestos siding encloses space below the hot-lime softener—the area being divided in two floors. Lime storage, sludge-recirculation pump, blowdown heat exchanger and flash tank are on the second floor. Ground floor houses two chemical tanks with agitators, decanting control for strong and weak lime solutions and two chemical-feed pumps. One of these lime feeders is for mill water, the other for handling condensate. Separate mill water and condensate flowmeters, with contacts for controlling individual lime feeds to the softener, operate in proportion to water flow. Percentage lime slurry in each case depends on water analysis.

While condensate flows to the softener uncontrolled, mill-water makeup feeds through a 10-in. control valve. Each enters the internal, direct-contact vent condenser and down-spray heater. Desludging is controlled automatically from the mill-water meter. But it's possible to manually adjust duration and frequency to meet special conditions. Softener overflow discharges to a circulating water tailrace used in conjunction with turboblower condensers. Softener operating pressure is 3-5 psi.

Based on an average analysis of Detroit city water, treated water leaving hot-lime softener is guaranteed to have not more than 50-ppm hardness, 32-ppm alkalinity and 1- to 2-ppm silica.

**Filters.** Leaving hot-lime softeners, water flows to a battery of nine pressure filters—six new, three existing shells. Anthracite filtering medium will yield a crystal-clear effluent.

Filtration rate is 3.1 gal per sq ft per minute, at 1,600,000-lb-per-hr total




**WATER-TREATMENT FLOW** diagram, simplified, traces flow through system components. To trace main water flow, start at mill-water header, *lower left*, and follow heavy solid line. The anthracite filter and zeolite softener represent several units

# Ford's new system yields virtually zero-hardness water

capacity for nine units. Resulting turbidity is guaranteed at less than 5 ppm.

Loss-of-head gage tells when filters need backwashing. Flowmeters on individual filters indicate flow rates to prevent filter overloading. New backwash pump takes suction from a wash-water outlet on the hot-lime softener, backwashes through a dirty filter and returns to the softener sedimentation tank. Same type existing pump backwashes zeolite softeners.

Filtered water enters zeolite softeners via three booster pumps on ground floor below the hot-lime softener.

**Hot-zeolite softeners.** Seven units operating in parallel are guaranteed to remove practically all traces of water hardness, as measured by Boutron and Boudet soap test. Water passes through an anthracite-supported bed of resinous zeolite rated at 2860 kilograins exchange per unit when using 0.275-lb salt per kilograin of hardness removed.

While Ford operators will run the softeners manually with valve-nest controls, duplex gages indicate rinse-to-waste rate, backwash rate, brine and solution water rates. Inlet meter tells them main flow.

Softener regeneration by brine system will keep these units running at a high level of effectiveness.

**DEAERATING HEATER**, thoroughfare design, is located on roof, but its load is carried by the storage tanks. Unit capacity is 1,500,000 lb per hr

**Deaerating feed heater** shown above, can deliver 1,500,000-lb-per-hr feedwater at saturation temperature corresponding to deaerator shell pressure, and will contain not more than 0.005-ml oxygen per liter, thus meeting requirements.

To accomplish deaeration, 5-lb steam from exhaust lines or reducing-desuperheating station enters atomizers. This breaks up preheated water and scrubs out noncondensable gas. Steam leaving atomizers flows to the preheating section

# PRINCIPAL POWER-PLANT EQUIPMENT—PART III: WATER-TREATMENT SYSTEM

**Rouge Plant, Power House No. 1, Ford Motor Company, Dearborn, Mich.**

### WATER-TREATING EQUIPMENT

Hot-lime softener, 1 ..... Cochrane Corp
200,000 gph, 43-ft dia, spheridome top, 45-deg cone bottom, internal uptake funnel, eight 22-in.-dia tubular supports, combined internal direct-contact vent condensers and down-spray heaters (gas concentrators), fifteen 12-in. spring-loaded vacuum breakers. Chemical feeding equipment: two, 10 ft-9 in. dia by 6-ft straight-shell chemical tanks, dished bottom, 1520-lb capacity, 5%-suspension hydrated lime, flat top with charging door. Decantrol lowering mechanisms: 2 pantograph swing pipe. Propeller agitators: 2 Lightnin LD-300, direct drive

Filters, 6 new, 3 existing ..... Cochrane Corp
Horizontal type, 8-ft dia by 16-ft length, anthracite filters, valve-nest control, 1,600,000 lb per hr at 3 gal per sq ft per min

Hot-zeolite softeners, 7 ..... Cochrane Corp
9-ft dia by 6-ft straight shell, with resinous zeolite, 2860 kilograins exchange using 0.275-lb salt per kilograin hardness removed, 5-in. valve-nest control, 7 water meters with alarm contacts. Brine measuring tank: one, 4½-ft dia by 4-ft straight side, flat bottom, interior Apexior coating

Deaerating heater, 1 ..... Cochrane Corp
1,500,000-lb-per-hr outlet capacity, thoroughfare type, horizontal, 9-ft dia by 29-ft length, atomizing deaerator, 4 preheaters, mounted above roof, supported on existing sedimentation tanks (converted to storage tanks)

### PUMPING EQUIPMENT

Boiler-feed pumps, 4 ..... Allis-Chalmers Mfg Co
6x5 MJ-4, 1350 gpm, 915-ft head, 12-ft npsh, 230 F, 500 hp, horizontally split, 4 stage, double suction, cast-iron casing, 3 turbine driven, 1 motor driven

Boiler-feed-pump turbines, 3 ..... Elliott Co
500 hp, type 2 CYR, 1760 rpm, inlet steam, 250 psi, 650 F, exhaust steam 10 psi, constant-speed governor, overspeed governor, 53.5-lb water rate

Booster pumps, 3 ..... Worthington Corp
Type 6-L-3, 1750 gpm, 110-ft head, horizontally split, single stage, double suction, centrifugal; motor driven, 75 hp, 1750 rpm

Condensate pumps, 2 ..... Byron-Jackson Co
8-in. M-type U, 1750 gpm, 130-ft head, horizontally split, single stage, cast-iron casing, bronze fitted, centrifugal; motor driven, 75 hp, 1750 rpm

South hotwell pump, 1 ..... Ingersoll-Rand Co
Size 3UV, 480 gpm, 160-ft head, horizontally split, single stage, cast-iron casing, centrifugal; motor driven, 30 hp, 3450 rpm

Sludge-recirculating pump, 1 ..... Ingersoll-Rand Co
For hot-lime softener, type 3-CORVL-3, 334 gpm, 23-ft head, all-iron open impeller; motor driven, 5 hp, 3450 rpm

Chemical-feed pumps, 2 ..... Ingersoll-Rand Co
For hot-lime softener, type 1-ORVN-2, 20 gpm, 90-ft head, all iron, open impeller; motor driven, 2 hp

Brine-transfer pumps, 2 ..... Ingersoll-Rand Co
For hot-zeolite softeners, type 1-KRVS-3H, 15 gpm, 120-ft head, all bronze; motor driven, 3 hp, 3450 rpm

Brine pumps, 2 ..... Ingersoll-Rand Co
For hot-zeolite softeners, type ¾-CKRVS-¾ D, 15 gpm, 50-ft head, all bronze; motor driven, ¾ hp, 3450 rpm

Backwash pump, 1 new, 1 existing ..... Worthington Corp
Type 6-L-1, 1600 gpm, 60-ft head, horizontally split, single stage, double suction, centrifugal; motor driven, 30 hp, 1750 rpm

Chemical-feed pump and tank, 1 ..... Milton Roy Co

### INSTRUMENTS AND CONTROLS

Automatic desludging valve, 1 ..... Fisher-Governor Co
For hot-lime softener, type 555-2 diaphragm motor, air operated, cycle timer, solenoid air valve

Flowmeters, 2 ..... Hagan Corp
For hot-lime softeners, integrating, indicating, recording, with contacts for chemical feeds

Level controllers, 3 ..... Fisher-Governor Co
Pressure gages, 17 ..... Crosby Steam Gage & Valve Co
Thermometers, 4 ..... Moeller Instrument Co
Instruments and panel ..... Bailey Meter Co
Pressure-reducing, desuperheating station ..... Republic Flow Meters Co

### PIPING SYSTEM

Piping fabrication ..... Lorne Plumbing & Heating Co; Herman Goldner Co
Piping erection ..... Lorne Plumbing & Heating Co
Valves ..... Cochrane Corp; Fisher-Governor Co; Wm Powell Co; Walworth Co; Leslie Co; Chapman Valve Mfg Co
Piping and fittings ..... Harry W Taylor Co
Expansion joints ..... Zallea Brothers
Piping insulation ..... Armstrong Cork Co
Motor-operated butterfly valves, 36 in., 3 ..... S Morgan Smith Co

### MISCELLANEOUS

Electric hoist, 1-2 tons ..... Detroit Hoist & Machine Co
Motors ..... General Electric Co; Allis-Chalmers Mfg Co; Reliance Electric & Engineering Co
Motor-control centers, 3 ..... Westinghouse Electric Corp
Electrical lighting and wiring ..... Harlan Electric Co
Flash tank, 1 ..... Buffalo Tank Corp
Condensate tanks, 2 ..... Buffalo Tank Corp
Piling and foundations ..... Spencer, White & Prentice
Concrete work ..... Perron Construction Co
Structural-steel erection ..... Tri-State Steel Erection Co
Structural-steel fabrication ..... Ford Motor Co Fabricating Shop
Corrugated siding ..... H H Robertson Co
Softener erection ..... Chicago Bridge & Iron Co

***Engineers and constructors*** ..... The Kuljian Corporation

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where incoming water sprays through four preheaters. From here steam goes to heating section of the hot-lime softener where vent-condenser action moves noncondensable gases.

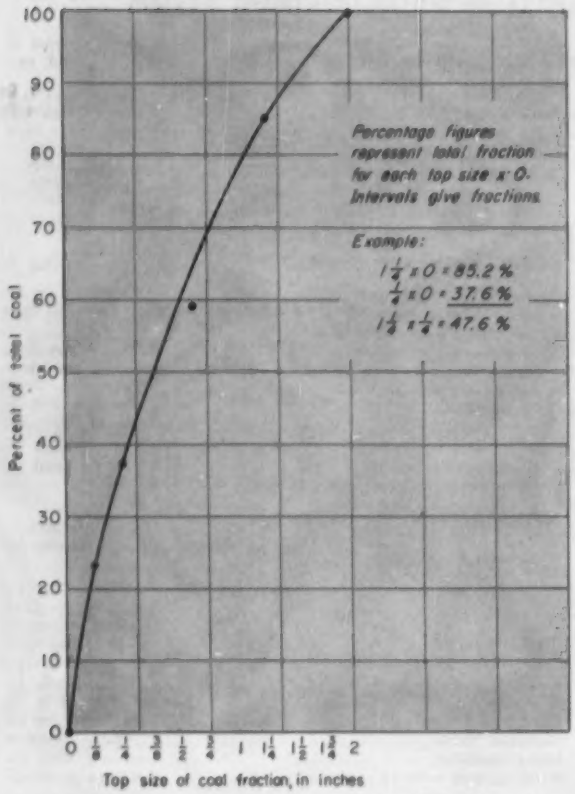
Three 36-in. motor-operated butterfly valves bypass steam around the deaerator. These represent substantial savings compared to gate valves. Blanking plates take care of leakage (about 1%) when valves are shut off for maintenance or repair.

Rather than allow old hot-process softeners to go unused, Ford and Kuljian engineers will let them serve as deaerated-water storage tanks. They also support the new deaerating heater above the powerhouse roof.

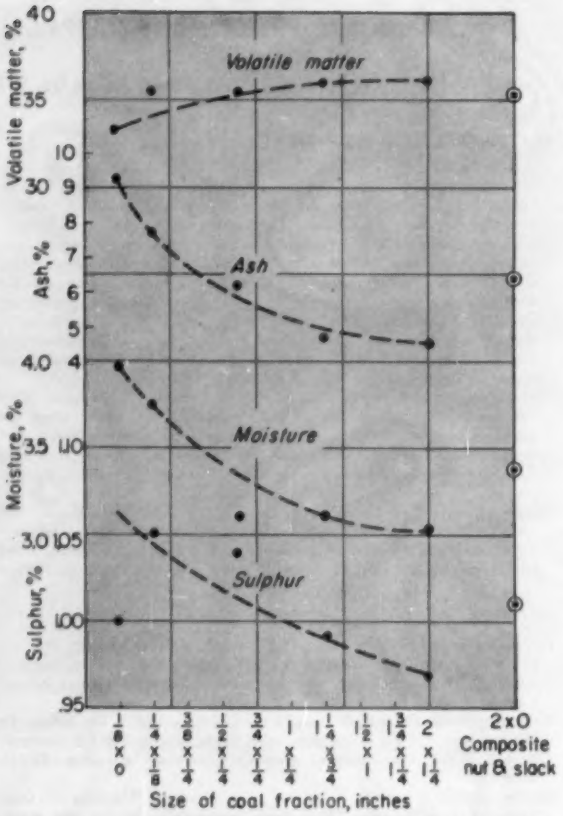
**Boiler-feed pumps.** Four units—one motor driven, three turbine driven—can each deliver 1350 gpm of 230-F water at 915-ft head, with 12-ft net-positive-suction head. Npsh is important here because boiler-feed pumps are at same level as deaerated-water storage tanks, allowing enough head for about 10-minute storage.

Boiler-feed-pump turbines take 250-psi, 650-F steam and exhaust at five lb to the deaerating heater. Motor drive is a 500-hp splashproof induction machine operating at 2300 v.

**Electrical.** System design conforms to most modern practice. Three-phase, 60-cycle electrical power, 2300 and 440 v, comes from existing substations. Boiler-feed-pump motor connects to an electrically operated circuit breaker on existing 2300-v switchgear. All other motors are 440 v. These hook up to across-the-line combination magnetic starters with air circuit breakers mounted in three groups of motor-control centers. All power and control wiring runs in rigid steel conduit.


Percent of total coal
Top size of coal fraction, in inches
Percentage figures represent total fraction for each top size x 0. Intervals give fractions.
Example:
1½ x 0 = 85.2 %
¼ x 0 = 37.6 %
1½ x ¼ = 47.6 %

1 Cumulative curve for a shipment of 2x0 coal shows distribution of different-size fractions, example shows its use




2 Analyses show that coal fines have higher ash, moisture, and sulfur, but lower volatile matter—a poorer coal

# Coal giving trouble? Check its size consist

**Even if coals come from the same strata in a mine, that does not mean they're all alike. Here's what one coal buyer found out about influence of size distribution in fuel he bought**

By C W STEVENS, *Dayton, Ohio*

► We began getting large clinkers in our underfeed-stoker-fired boiler furnaces. Something had changed and we had a hunch the coal had a greater percentage of fines than before. From its behavior on the stokers, the coal seemed to have more ash, lower heat content, lower fusion characteristics. Fires definitely acted differently from usual.

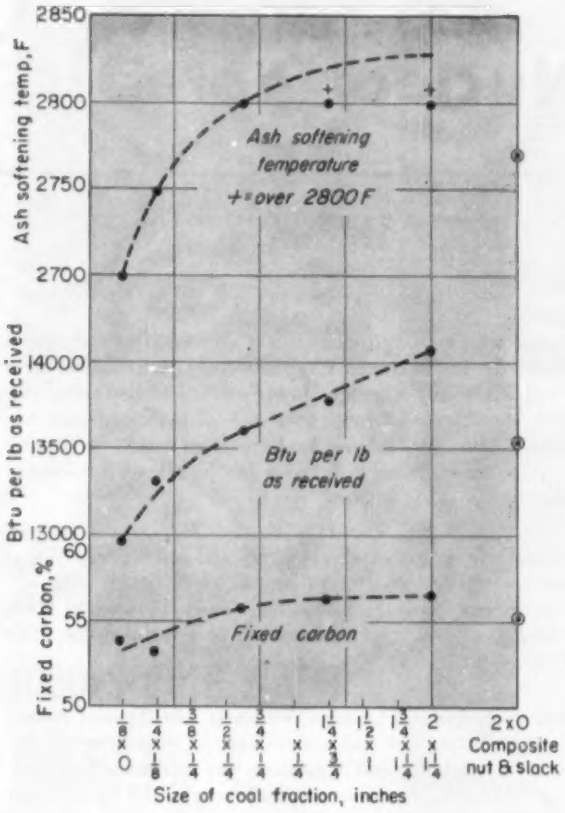
Our coal suppliers assured us we were getting the same coal as always. It was from the same mine and tipple, with no change of any kind. We found no easy answer to our troubles.

**Suspect fines.** We knew from experience that the percentage of fines or, in other words, the size consist (proportions of the various sizes), affected firing behavior. On stokers especially, a greater proportion of fines changed windbox pressures, blowing through the fuel bed, clinkering, flame density, rate of burning, steaming capacity and other conditions.

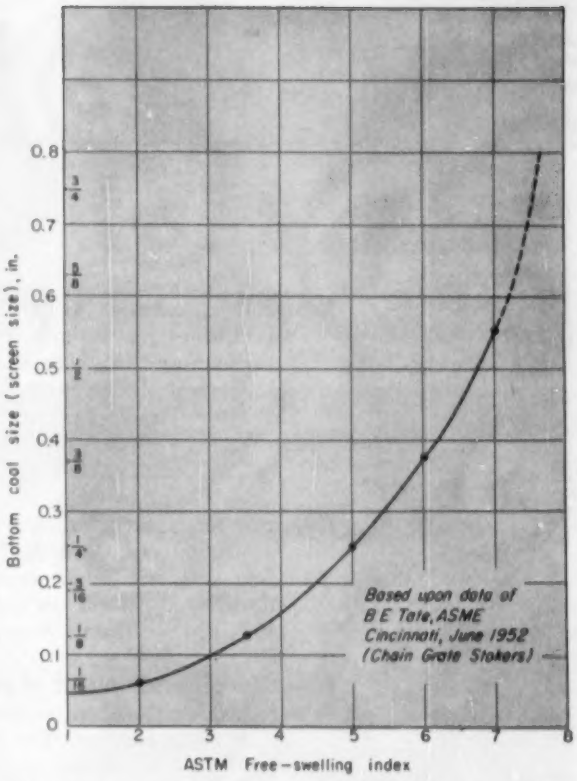
**Research.** With this hunch and past experience with fines, we decided on a bit of research. We ran large coal samples through nesting sieves. These had holes varying from ⅛ up to 2 in. The slack coal we were measuring was rated at 2x0 in. We weighed the fraction of coal remaining on each screen and converted these to percentages of the whole sample.

Fig. 1 shows the smooth curve drawn through the points representing cumulative totals starting with the smallest sizes. The percentage of any size from zero, or between given sizes, can be figured by interpolation as example on the graph shows.

We took samples of these screenings of definite-size range and ran chemical analyses on them. These determined percentage of (1) volatile matter (2) fixed carbon (3) ash (4) moisture and




**3** In addition to lower fixed carbon and heating value, coal fines also have markedly lower ash-softening temperature




**4** Tests on screened stoker coals showed that free-swelling index increased as the smallest size included was raised

(5) sulfur. We also found ash-softening temperature and heating value of each fraction. Besides these analyses we got the same data on a sample of the complete 2x0 coal as received.

**Results.** Fig. 2 and 3 show the results of these analyses plotted as smooth curves. While the small sizes seem to show some inconsistency on sulfur, note the relatively large scale used compared with the other components. Analyses of the aggregate 2x0 sample are plotted as single points to the right of each graph.

Consistency of the curves clearly showed a definite relation between fraction size and the coal factors. The single points for the entire coal fall correctly within the range of each curve.

These curves were made up from a limited number of samples of a single type of coal. They can't be used as a universal set of curves applicable to all coals used in steam power plants. You can easily make up similar curves for the coal you burn.

**Analysis.** Our curves explained a number of the problems we were having:

1. A high percentage of fines reduces the ash-softening temperature as much as 100 F. This alone may give us more and larger clinkers.

2. Fewer Btu in the extra proportion of fines means we have to burn more coal to produce a given amount of steam. This higher firing rate may aggravate clinkering.

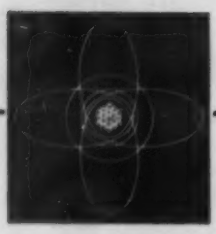
3. Higher ash content may form larger clinkers, particularly if more iron accompanies the higher sulfur content to produce massive, dark, fusible clinkers. Lime and alkalis may also be associated with the sulfur. These tend to form lower melting eutectics with refractory silica and alumina contained in the ash.

**Buying coal.** Frequently a mine may not have the coal size in stock that you normally buy. They may want to ship you a different size of the same coal. We had a case where 2x0 coal was offered as a substitute for the ¼x0 normally used. The larger sizes are easier to handle in freezing weather and have a higher heat content than the finer sizes. But the price is higher.

Curves like those above give us the tools with which to check the relative quality of various size proportions and let us know what we can afford to pay. For our stoker clinker problem, we concluded that we should use a rescreened coal with a reduced content of the ⅜x0 size. This greatly reduced our clinkering troubles.

**More data.** In the investigation we carried on, we also tested various types of coal to relate the size ⅜x0 coal to the ASTM free swelling index. The tests were made on double-screened coal with 30, 40 and 50% of ⅜x0 in the size consist of the aggregate. We found that the higher the free-swelling index, the lower the percentage of fines had to be. The less caking or more free-burning the coal, the greater the percentage of fines needed.

A coal with a free-swelling index of 4, for our underfeed stokers, ran best with about 50% fines. A coal with a free-swelling index of 7 got by with 30% fines. Formation of plastic agglutinated layers gives needed air distribution and uniform burning. With free-burning coals the fines fill the interparticle spaces and prevent blowing of the air through the fuel bed. Fig. 4 shows the relationship between the free-swelling index and the coal fines for one industrial plant using chain-grate stokers.



# Nuclear notes

By B G A SKROTZKI, *Associate Editor*

**Radioactive excitation of carbon** to release 78.3 million Btu per lb will be investigated by Colonel Harry Hardsog (retired) for Fairchild Engine and Airplane Corp. In a lab at Northboro, Mass., he will study his "quantum jump" theory of fissioning carbon atoms. He believes carbon atom can be broken into one of hydrogen plus one of boron plus 16 mev of energy. Discovery seems to have been made in testing about 2 lb of insulating tar that exploded and wrecked a lab building. Subsequent test on 0.001 gram of coal wrecked the calorimeter.

**American Nuclear Society** was founded by group of 29 engineers and scientists in Washington, D.C., on Oct 11th. New societyseeks charter in New York State. It will provide a forum for discussing problems relating to nuclear energy, ranging from theory to actual reactors and biological effects. First meeting is scheduled for June 1955 at Pennsylvania State University.

**Enrico Fermi, professor of physics,** University of Chicago, won first AEC Special Award for his contributions to basic neutron physics and achievement of the controlled nuclear chain reaction. The award of $25,000 and a citation was announced on Nov 16th. Prof Fermi died on Nov 28th. His contributions had been noted in the past by awarding of the Nobel Prize and other honors.

**Eighteenth study** in Industrial Participation Program has been approved by AEC. Kaiser Engineers Division of the Henry J Kaiser Co. will carry on this study. The company plans to spend $100,000 the first year to survey power-reactor technology and find out research and development needed before building a reactor.

**New joint study team** for nuclear power was formed by American Gas and Electric Service Corp, Bechtel Corp, Commonwealth Edison Co, Pacific Gas and Electric Co and Union Electric Co of Missouri. They propose taking three steps: (1) select a reactor design and appraise it economically (2) evaluate practicability, financing, construction and operation of a nuclear power-plant design (3) proceed with the building of a nuclear plant upon approval of AEC.

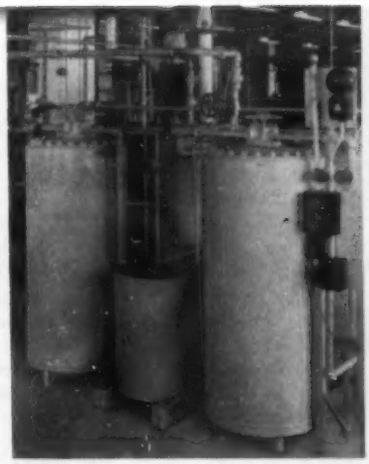
**Five-company group** selected a full-time staff headquartered in Chicago. Present activities of staff center on studying boiling-water reactor principle developed by Argonne National Laboratory and the homogeneous type developed by the Oak Ridge National Laboratory. Future organization for steps two and three will depend on many factors unknown at present time.

**No future in power reactors** unless we can find ways of manufacturing fuel elements and reprocessing materials cheaply, says Dr L R Hafstad, former director of reactor development, AEC. We still need a fuel element that stands high burn-up to give us long life needed in commercial power reactors. Hafstad urges that US industry build an engineering test reactor for full-size fuel elements.

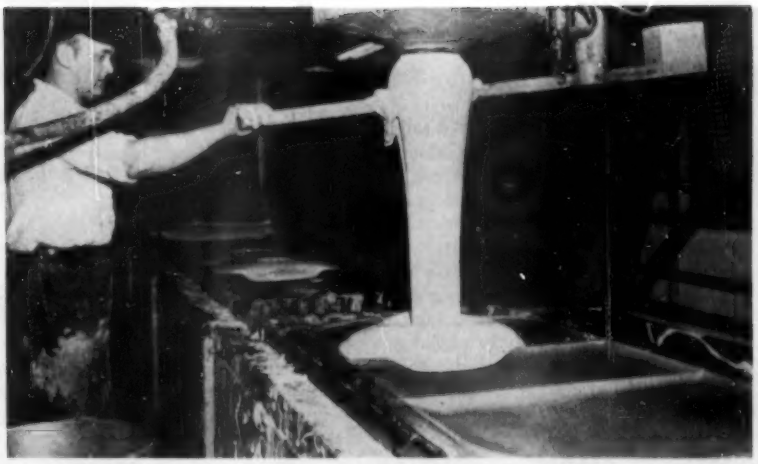
**USA has no monopoly** on atomic knowledge, says Hafstad. We can expect European nations to take aggressive part in international pool arrangement. They will compete with American industry for research- and power-reactor markets in undeveloped countries. American industry cannot afford to wait for government to take all the risks in developing commercial power reactors.



DEMINERALIZER continued

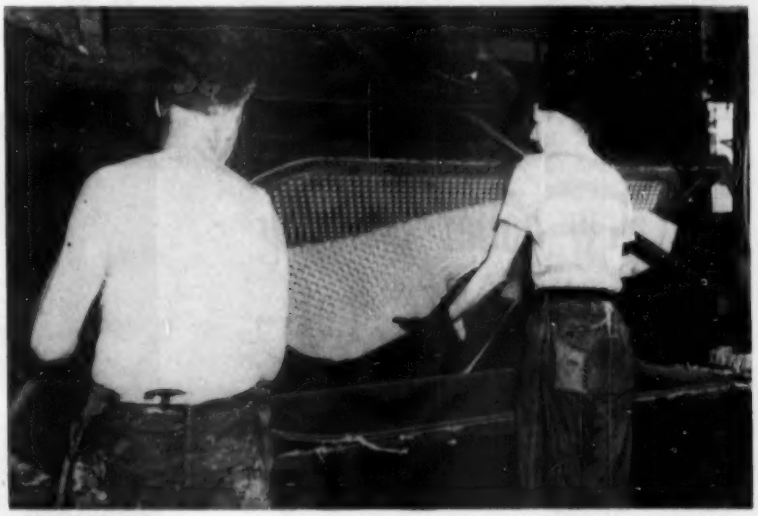


**UNIT** purifies water for making Airfoam



**PURE WATER** helps prevent premature coagulation of the liquid latex raw material

# Now demineralizer meets pure-water needs for handling latex



**REMOVING** Airfoam from mold after original raw material has been cured in oven

By **J E BURWELL**, *Airfoam Development Dept, Goodyear Tire and Rubber Co*
and **ESKEL NORDELL**, *The Permutit Company*

► DEMINERALIZATION by ion exchange has come into wide use in a larger number of fields because of its extremely economical operating costs as compared with distillation. Here at Goodyear we took advantage of the cost angle in two Airfoam-producing plants. Both our Akron and our Los Angeles factories are now meeting their pure-water needs with demineralizers.

These plants need relatively pure water to give a high-quality product and to reduce processing problems. Water goes into natural- and synthetic-latex raw material during compounding in manufacture of Airfoam.

Rubber particles in the latex carry a negative charge. And strong positive ions cause them to coagulate. Divalent ions such as calcium, magnesium, zinc and iron produce this premature coagulation of the rubber particles. This not only affects quality of the product but, if allowed to continue, results in processing difficulties and excessive waste. So we use high-quality water as the base material for all compounding dispersions as well as for final dilution to control total solid content.

Originally, both plants got their process-water supply by distillation. But with ever-increasing production this source became uneconomical because of the large volume needed. And demand strained available steam-producing facilities.

When Airfoam expanded in 1947-48, softened water was considered. But data available showed that this source of process water was not suitable. Softening merely converted calcium and magnesium salts to sodium salts. This was considered undesirable although not harmful. So the scheme was dropped.

Additional expansion in 1950-51 brought up the water-supply question again. Estimated distilled water needs for the Akron plant were such that powerhouse facilities would have been sorely taxed for production processing as well as steam for distilled water. So we went to the water-treating-equipment manufacturers again. This time we decided to use demineralizers.

Ion-exchange units now installed in both plants produce demineralized water continuously. Water is not only free of calcium and magnesium, but also of sodium salts. Purity of the effluent is

## DEMINERALIZER continued

3-ppm to 5-ppm of total dissolved solids.

As alkalinity of water can also be controlled and effluent is iron free, we found we are getting considerably higher quality than we did from the distillation equipment.

Two 28-inch-diameter units have been in continuous operation at Akron since 1950. We selected similar units for Los Angeles. In both plants, the cation exchanger is Zeo-Karb H and the anion exchanger is Permutit S, a highly basic exchanger. Here are the results we are getting from the units:

**Akron, Ohio plant**

| *Before demineralization:* | *ppm* |
|---|---|
| Total hardness | 150 |
| Total dissolved solids | 165 |
| Silica | 4.6 |
| *After demineralization:* | *ppm* |
| Total hardness | 0 |
| Total dissolved solids | 3 |
| Silica | 0.1 |

**Los Angeles, California plant**

| *Before demineralization:* | *ppm* |
|---|---|
| Total hardness | 209 |
| Total dissolved solids | 282 |
| Free iron | 0.1 |
| Silica | 24 |
| *After demineralization:* | *ppm* |
| Total hardness | 0 |
| Total dissolved solids | 5 |
| Free iron | 0.025 |
| Silica | 0.1 |

While cost figures are not readily available, we feel that our demineralizers are saving us a considerable amount, compared to the previous distillation setup. Operation of the units has been relatively simple. The routine control tests can be run rapidly and with positive results.

# New boiler cleaning method uses shot—helps one plant save

► NEW SWEDISH boiler-cleaning system uses granulated pig-iron pellets. Irregular-shaped shot falls on economizer and air-heater surfaces, knocking off soot deposits as flakes and dust. Continual use prevents further soot formation.

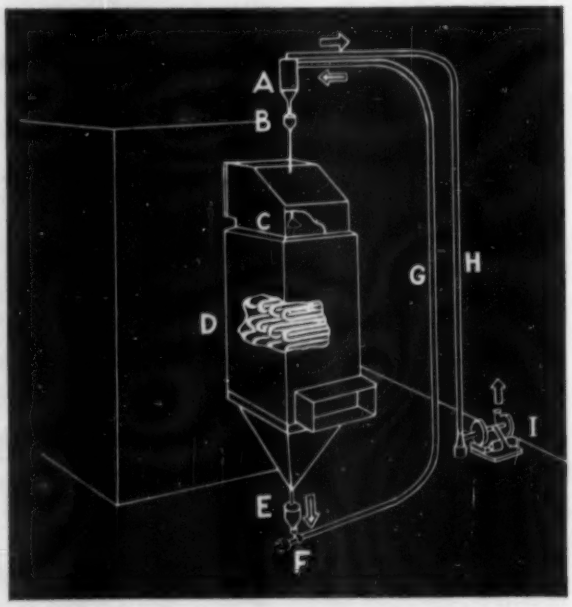
The process, called the Broman system (sketch at bottom), is as follows: Shot collects in hopper *A*, goes through distributor *B* to one or more spreaders *C*, below. Shower of shot, evenly spread, falls by gravity over heating surfaces *D*.

Used shot collects in separator *E* where soot cakes and larger flakes are removed. Injector *F* finishes cleaning job and shot is sucked through pipeline *G* back to hopper. Air continues through pipe *H* to suction fan *I*.

System can be used on coal- or oil-fired boilers. And it is adaptable to many different heating-coil setups. For severe soot problems, continuous operation is used. "Normal" cleaning requires only 15 minutes each 8-hour shift.

One large Swedish industrial boiler plant gives this cost comparison for cleaning with steam as against the Broman system. On installation, steam would have cost $12,300, Broman cost $6800. Big saving is in operation: steam, $4150 per year; Broman $580 per year, a ratio of about one to seven.

**GRANULATED** pig-iron pellets used in Broman cleaning system




**SHOT** falls on surfaces by gravity, is sucked back to hopper

# Power's DATA SHEET

No. 271

## Investments for new steam-electric central stations 1945 to 1954, actual and estimated

| State | Number of: Plants | Units | Unit capacity range, mw | Fuel | Capability, total mw | Total cost $1000 | Unit cost, $ per kw |
|---|---|---|---|---|---|---|---|
| Alabama | 6 | 17 | 40-180 | C, G | 2,116 | 275,090 | 130 |
| Arizona | 3 | 4 | 11- 90 | G, O | 163 | 22,204 | 136 |
| Arkansas | 3 | 6 | 25- 60 | G, O | 348 | 31,194 | 90 |
| California | 10 | 28 | 20-125 | G, O | 2,658 | 369,769 | 139 |
| Colorado | 4 | 7 | 3- 40 | C, O | 168 | 25,194 | 150 |
| Connecticut | 1 | 1 | 60 | C, O | 75 | 15,200 | 202 |
| Delaware | 1 | 3 | 60 | C, O | 207 | 33,833 | 164 |
| Florida | 8 | 18 | 11- 60 | O | 664 | 91,648 | 138 |
| Georgia | 4 | 9 | 20-100 | C, O | 726 | 82,232 | 113 |
| Illinois | 7 | 21 | 20-150 | C, G | 2,054 | 343,779 | 167 |
| Indiana | 5 | 15 | 40-175 | C | 1,949 | 276,994 | 142 |
| Iowa | 6 | 9 | 5- 40 | C | 196 | 37,687 | 192 |
| Kansas | 3 | 4 | 15- 60 | G, C | 174 | 27,455 | 158 |
| Kentucky | 4 | 17 | 25-135 | C | 1,792 | 254,836 | 142 |
| Louisiana | 7 | 15 | 10- 60 | G, O | 551 | 60,705 | 110 |
| Maine | 1 | 1 | 8 | O | 8 | 1,716 | 207 |
| Massachusetts | 2 | 3 | 40- 60 | C, O | 198 | 44,570 | 225 |
| Michigan | 5 | 12 | 4-125 | C | 1,092 | 174,537 | 173 |
| Minnesota | 7 | 11 | 5- 60 | C | 240 | 44,071 | 184 |
| Mississippi | 4 | 8 | 30- 90 | G, O | 521 | 52,327 | 100 |
| Missouri | 7 | 11 | 7-110 | C, G, O | 599 | 95,871 | 160 |
| Montana | 1 | 1 | 60 | G, O | 66 | 5,537 | 84 |
| Nebraska | 1 | 1 | 60 | — | 66 | 14,000 | 212 |
| New Hampshire | 1 | M** | 40 | O, C | 46 | 12,668 | 275 |
| New Jersey | 1 | 4 | 110-125 | C, O | 455 | 58,341 | 128 |
| New Mexico | 3 | 3 | 6- 40 | G, O | 81 | 11,763 | 145 |
| New York | 8 | 12 | 20-180 | C, O | 852 | 127,327 | 150 |
| North Carolina | 4 | 9 | 40- 90 | C | 673 | 65,640 | 98 |
| North Dakota | 2 | 3 | 4- 7 | C | 17 | 5,256 | 309 |
| Ohio | 9 | 25 | 40-180 | C | 3,052 | 423,581 | 139 |
| Oklahoma | 4 | 5 | 5- 60 | G, C | 257 | 31,497 | 123 |
| Pennsylvania | 11 | 23 | 20-200 | C | 2,056 | 334,306 | 163 |
| South Carolina | 3 | 7 | 20- 60 | C, O | 332 | 44,844 | 135 |
| Tennessee | 4 | 18 | 112-250 | C | 3,036 | 419,095 | 138 |
| Texas | 11 | 14 | 30-100 | G | 772 | 79,231 | 103 |
| Utah | 1 | 2 | 60 | O | 138 | 21,946 | 159 |
| Virginia | 4 | 8 | 30-160 | C | 663 | 98,006 | 148 |
| West Virginia | 4 | 9 | 50-175 | C | 1,203 | 132,253 | 110 |
| Wisconsin | 4 | 5 | 4-120 | C | 281 | 50,840 | 181 |
| Wyoming | 1 | 2 | 10- 11 | C | 23 | 3,427 | 146 |
| USA | 175 | 372 | 4-250 | | 30,616 | 4,309,213* | 141 |

*Includes $2,725,000,000 of estimated cost; remainder is final investment  **Mercury-steam unit  Source: Federal Power Commission

POWER pays $35 for each accepted Data Sheet. Why not submit yours today?

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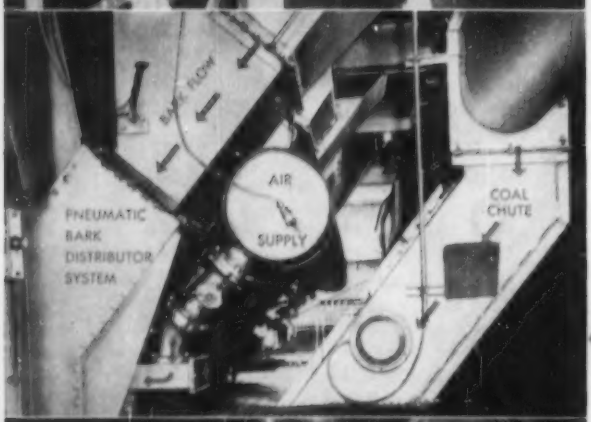
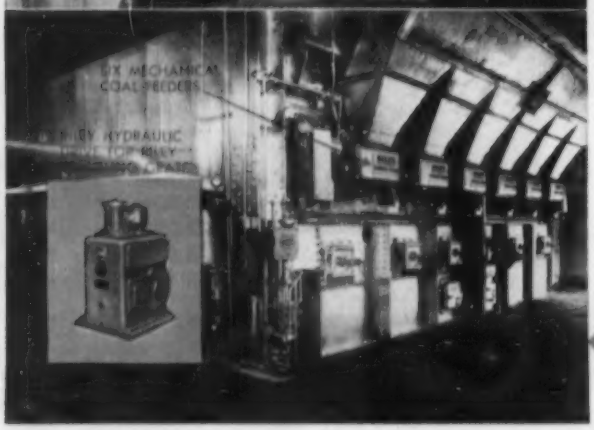



*Something new in fuel burning*

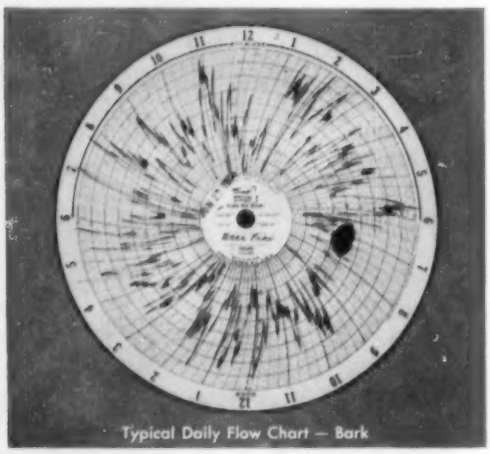
by **RILEY**

**AT CHAMPION PAPER & FIBRE CO.**
**Canton, North Carolina**

**LEGEND**

**Illustration 1 —**
Unhogged bark on last stage of bark conveyor is weighed; weight is automatically combined with coal feed rate to provide balanced combustion controls against minimum load setting (200,000 lbs/hr).

**Illustration 2 —**
Riley Rotating Bark Proportioner distributes bark into six chutes in a 1-4-2-5-3-6 sequence. Chutes lead to six Riley Pneumatic Bark Distributors. Distributors have no moving parts and their adjustment and maintenance requirements are minor.



Typical Daily Flow Chart — Bark

**Illustration 3 —**
Bark falls onto the six Pneumatic Distributor Trays where it is blasted into furnace by powerful air jets. Coal and bark burning simultaneously, give even flame distribution from front to rear of furnace.

**Illustration 4 —**
Coal feed is by six Riley Overthrowing Mechanical Coal Feeders. Self-lubricating Riley Hydraulic Units drive the Riley Traveling Grate at a controlled rate at any speed from zero to thirteen feet per hour. Front and rear overfire air jets provide turbulence to reduce flyash.

***RILEY DESIGNS, MANUFACTURES AND INSTALLS COMPLETE STEAM GENERATING UNITS AND***

# unhogged BARK burns with COAL

*simultaneously! efficiently!*

## A COMPLETE RILEY STEAM GENERATING UNIT

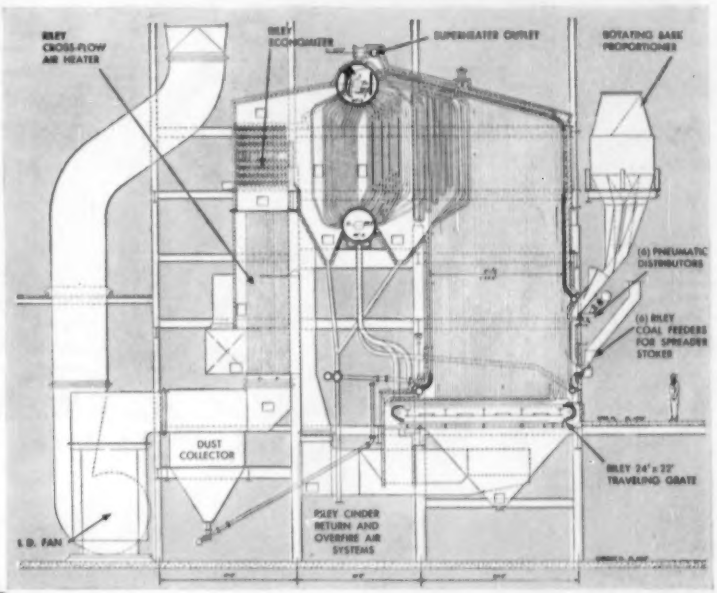
Bark and Coal Fired with Riley Traveling Grate Spreader Stoker

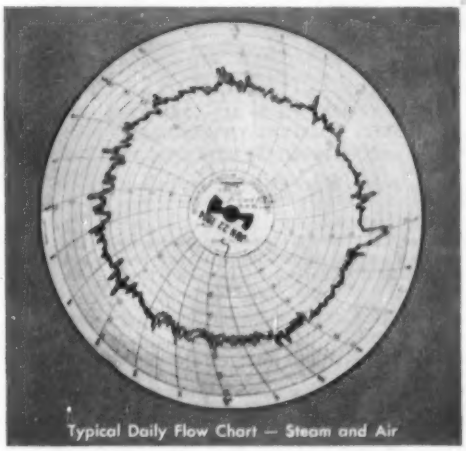
**Steam Capacity — 250,000 lbs/hr 500 psig, 750F.**

***featuring***

- **Riley Rotating Bark Proportioner**
- **Riley Pneumatic Bark Distributors**
- **Riley Overthrowing Coal Feeders**
- **Riley Traveling Grate (24'x22')**
- **Riley Hydraulic Drives**
- **Riley Cross-flow Air Heater**
- **Riley Cinder Return and Overfire Air Systems**
- **Riley Continuous Tube Economizer**

*a completely integrated Riley Unit*



Typical Daily Flow Chart — Steam and Air

This completely integrated Riley Steam Generating Unit at Champion Paper and Fibre Company, Canton, N. C. gives to the pulp and paper industry, and to others with refuse wood and cellulose burning problems, an entirely new technique in the science of fuel burning. Bark and coal can be burned alone or together in variable proportions under complete automatic control. New methods used at Canton permit efficient utilization of an extremely variable bark supply direct from barking drums, thus avoiding an expensive hogging and storage system.

For a complete description of this installation write for your copy of a paper prepared for TAPPI by Harold Hansen, Power Engineer, The Champion Paper and Fibre Company, and L. P. Copian, Service Engineer, Riley Stoker Corporation. Address Department A, Riley Stoker Corporation, Worcester, Mass.

*A survey of your plant by a consulting engineer could show ways of making surprising savings in your power costs.*

# RILEY

*Stoker Corporation*

**WORCESTER, MASSACHUSETTS**

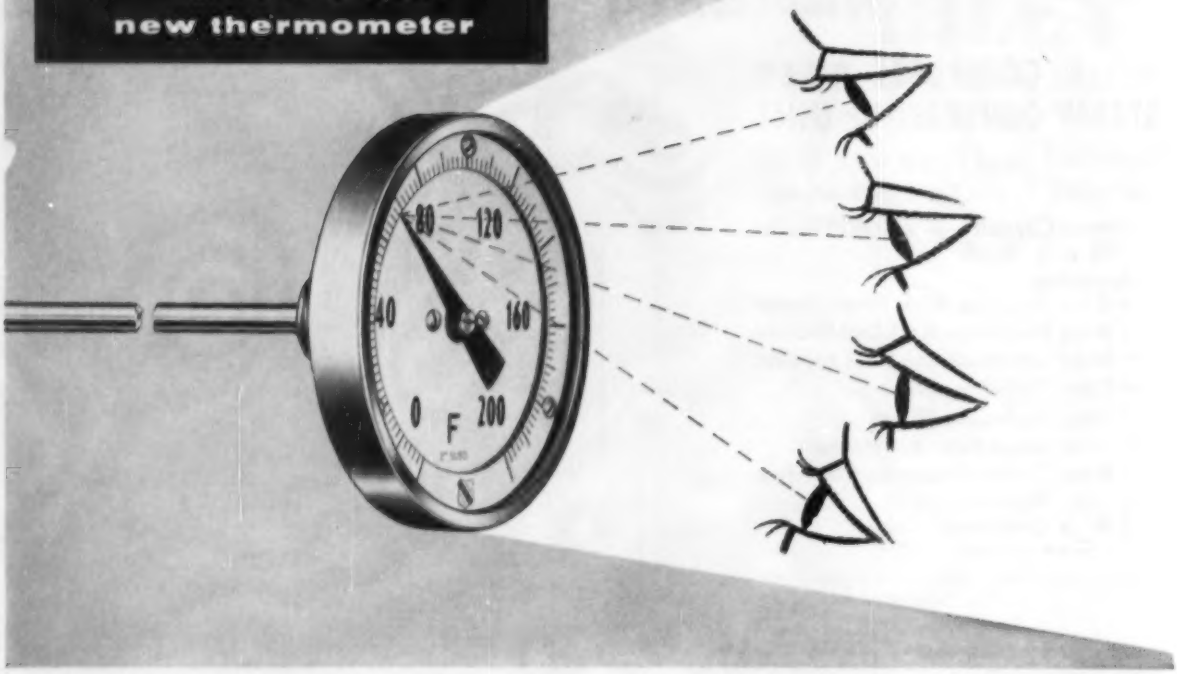
Boston, New York, Philadelphia, Buffalo, Washington, Pittsburgh, Cleveland, Detroit, Chicago, Cincinnati, Charlotte, New Orleans, Atlanta, St. Louis, Kansas City, St. Paul, Tulsa, Houston, Denver, Salt Lake City, Los Angeles, San Francisco, Portland, Seattle.

***FUEL BURNING EQUIPMENT FOR PUBLIC UTILITY AND INDUSTRIAL POWER AND HEATING PLANTS***

ANTI-PARALLAX

# MAXIVISION

is yours in this new thermometer




Now you can read temperatures *right at the process* with the same ease, accuracy and economy as pressure readings. The Anti-Parallax Maxivision Dial on this new all stainless steel American Bi-Metal Thermometer assures these important advantages. The large, easy-to-read black figures and graduations are carried on a raised ring set close to the glass, with pointer at the same level. Parallax error is practically eliminated.

With this new thermometer in service, field operators can eliminate frequent trips to the control house to observe process changes. Indoors or outdoors, this fine, all stainless steel American instrument is truly climate-proof. Because the case is only 3" in diameter, the thermometer fits where space is limited. Ample clearance behind the case makes installation easy and fast with a small wrench. Read the specification highlights, then get full details about this new high-accuracy American Bi-Metal Thermometer.

**PHONE your Industrial Supply Distributor** for prompt attention to your needs. He is always ready to help keep your production going by making fast delivery from local stocks.

## SPECIFICATIONS

**New AMERICAN ALL-STAINLESS STEEL BI-METAL THERMOMETER with ANTI-PARALLAX MAXIVISION DIAL**

**Dial:** Exclusive anti-parallax Maxivision dial, with scale approximately 6" long. Pointer set at same level as scale.

**Climate-Proof Case:** All stainless steel. 3" diameter. Threaded bezel. Selected clear, extra-heavy cover glass. Heat-resistant gaskets between glass and case seal the thermometer against rain, frost, sand, dust, fumes—climate-proof.

**Temperature Ranges:** From minus 80° to plus 1000° F. Accuracy within 1% of range.

**Low-Mass Bi-Metal Coil:** Welded to stem plug. Accurately centered in stem. Non-freezing, non-corrosive silicone fluid on coil dampens vibration, accelerates heat transfer, speeds response; does not gum, resists capillary action.

**Pointer:** Index type. Easily accessible from front of dial for positive adjustment over entire range. Pointer shaft guided by friction-free bearings.

**Stem:** 18-8 stainless steel, mirror polished. All joints welded. Resists corrosion. Provides strong, rigid and tight closure against process pressures. Lengths: 2½" to 24".

**Connection:** Fixed, ½" N. P. T.

**Separable Sockets:** Available for use in closed systems or where measured medium is corrosive to the stainless steel stem. Fit over all standard stem lengths except 2½".

**AMERICAN INDUSTRIAL INSTRUMENTS**

A product of **MANNING, MAXWELL & MOORE, INC.** STRATFORD, CONNECTICUT

MAKERS OF 'ASHCROFT' GAUGES, 'AMERICAN-MICROSEN' INDUSTRIAL ELECTRONIC INSTRUMENTS, 'CONSOLIDATED' SAFETY AND RELIEF VALVES, *Stratford, Conn.* HANCOCK VALVES, *Watertown, Mass.* 'CONSOLIDATED' SAFETY RELIEF VALVES, *Tulsa, Oklahoma.* AIRCRAFT CONTROL PRODUCTS, *Danbury & Stratford, Conn. and Inglewood, Calif.* "SHAW-BOX" AND 'LOAD LIFTER' CRANES, 'BUDGIT' AND 'LOAD LIFTER' HOISTS AND OTHER LIFTING SPECIALTIES, *Muskegon, Mich.*

**HAL KINNEY** explains maintenance and operation of diaphragm-control valves

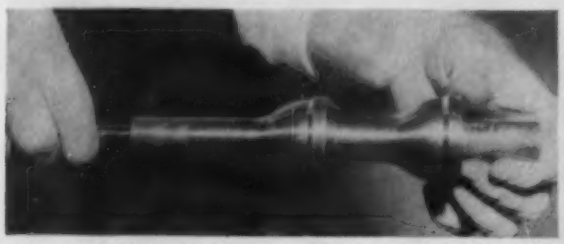
***Sponsored by the Instrument Society of America, the fifth maintenance clinic was held at University of Pennsylvania. POWER, covering the program, reports equipment manufacturers' inside tips. But even more important—first-hand experiences of operating and maintenance personnel. First session supplied these vital facts on . . .***

# How to get top performance from your control valve

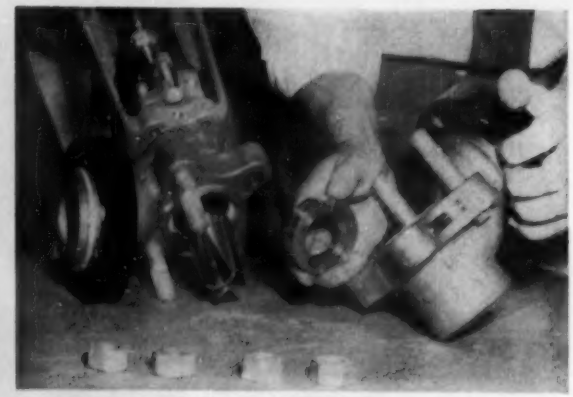
► HAL KINNEY of Fisher Governor Company concentrated on spring-diaphragm valves, while Jim Madison of Conoflow Corporation covered operation and maintenance of piston-operated valves. When comparing notes taken at these meetings we found basic differences as well as similarities. Let's take a close look at them.

**Valve operation.** Main difference between these two types is in method of response to input air signal. Spring-diaphragm valve controls flow by balancing air-loading pressure against a calibrated spring. Piston valve takes constant air-cushioning pressure on one side of piston, balances this against air-loading pressure from instrument. Third type — springless - diaphragm valve — operates in much the same way as a piston type. Springless operators can develop power necessary to operate valves against large unbalanced forces.

**Maintenance problems.** Main sources of trouble are erosion—mechanical action due to impingement of flow, and

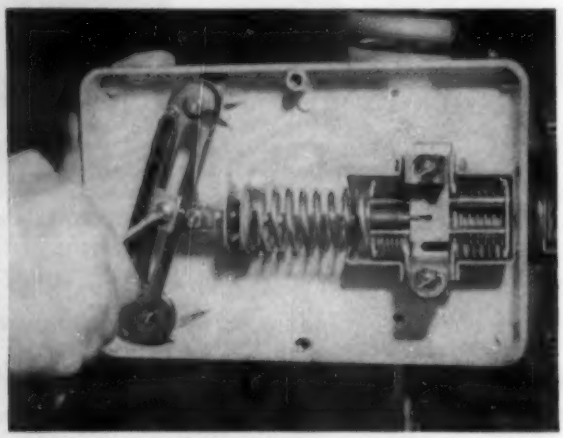


**INNER VALVE,** double port, plug type, is examined for galling and scoring. Severe scoring can result in sticky valve action



**SEAT RING AND PLUG INSPECTION** of one-port valve. This seat ring can be reversed if eroded on the original seat surface

**PISTON-CYLINDER VALVE OPERATOR** should be checked at intervals. Worn piston ring will cause operation that's sluggish



**POSITIONER-ADJUSTING SCREW** sets valve travel. Starting point pressure is changed by turning the knurled spring nut

corrosion—chemical action of flowing medium on valve parts.

Wire drawing between plug and seat is common cause of erosion. Operators as well as manufacturers agree that where plug rides too close to valve seat you'll eventually run into this condition. When valve port is too big to control flow (oversized valve), control system tends to close off flow passages. Resultant close clearances cause high-velocity fluid to erode valve material. Smaller size valve or reduced port (if you expect larger flows in the future) will lick this trouble.

High pressure drops also tend to erode valve materials coming in contact with flowing fluid. Where high-pressure drop is a must, consider hard surfacing of valve plugs and seats with stellite—ground and lapped. On high-temperature steam applications, stellite on guide members prevents galling and seizing.

Avoiding corrosion is mainly a matter of picking right valve materials. Most likely spot for corrosive action is where fluid moves at highest velocity. So we usually call for special materials on valve trim (seat ring, plug, stem and guide bushings). Commonly used trim is 304 or 316 stainless steel. But for highly corrosive fluids, check with valve manufacturer on monel, Hastelloy or nickel.

High-tensile iron is a good valve-body material up to 250 psi, 410 F, or 400 psi, 100 F. Up to 850 F manufacturers usually recommend cast carbon steel. Valve bodies for more severe service are of alloy steels such as chrome-moly.

**Installing new valve.** At this stage, careful attention to details avoids many common operating troubles before they have a chance to get started. Make sure all air connections are tight. Loose fittings lead to poor valve response, excessive air consumption and, in extreme cases, dirt-clogged systems.

Filter and regulate plant air supply as close to valve as possible. Clean air supply at right pressure minimizes valve-operator maintenance as well as improving control accuracy.

If specified loading pressure range does not stroke the valve, likely sore spot is misalignment of plug and seat. If it can't be easily corrected, you'll do well to call in the valve supplier.

Where large valve-stroking force and

**Modernization Awards**

To learn how you can win recognition for your accomplishments, see pp 80-81.

**DIAPHRAGM** operator must be pliable. Stiff diaphragm can't respond properly

**TEFLON PACKING** is examined for wear. Regular check avoids leaky stuffing box

close control are necessary, positioner is used to constantly compare input signal to valve position. If these don't match, positioner provides increased loading pressure necessary to correct flow through valve. New positioner should be checked and adjusted to set correct range-starting point. This usually amounts to nothing more than turning a zero-adjustment screw. Range spring determines total travel. While it is factory set, a field check, to see that you're getting correct stroke, will avoid operating difficulties later.

In preparing the pipeline itself, make sure it's free from dirt and scale. Lining up all piping carefully avoids twisting and bending strains on the valve body. If control valve is in an important position, use a bypass and block valves to insure continued operation—even when control valve is temporarily out of service.

**Stuffing box.** Inspect regularly to

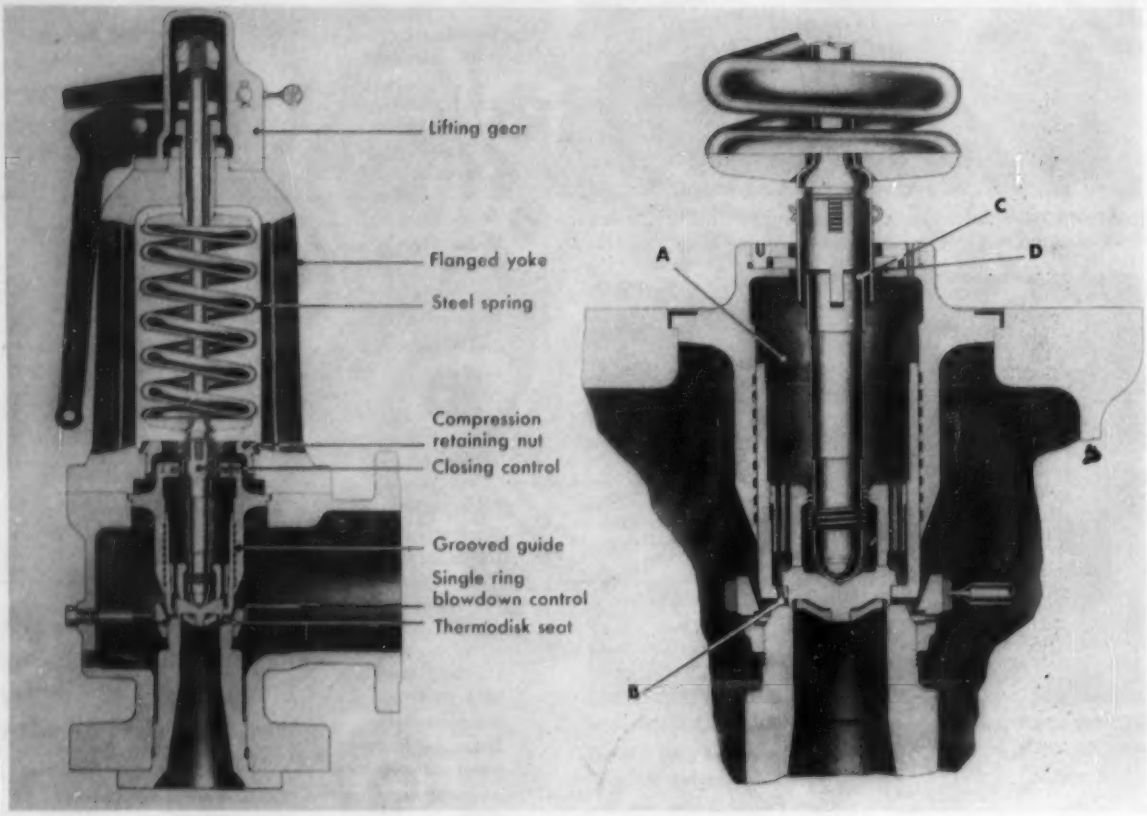
(*Continued on page* 200)

## How to correct common control-valve troubles

| Complaint | Cause | Cure |
|---|---|---|
| Valve cycles | Control system | Widen control band |
| | Valve oversized | Use reduced trim or smaller valve |
| | Sticking air-supply regulator | Clean or replace it |
| | Positioner out of adjustment | Readjust, set all points, check range |
| Valve sticks or jerks | Galled stem | Clean or replace it |
| | Galled trim | Clean or replace it |
| | Cushion-air load too low | Increase loading |
| | Packing too tight | Loosen or repack |
| | Diaphragm stiff | Replace it. If temperature is very high, use silicone diaphragm |
| | Cylinder fouled (for piston operated valves) | Clean walls and piston ring |
| | Dirty positioner | Disassemble and clean |
| Valve leaks at stuffing box | Loose packing | Tighten until leak stops |
| | Worn or scored packing | Replace packing |
| | Galled stem | Clean or replace |
| Valve leaks at body joint | Leaky gasket | Replace gasket |
| | Loose bolts | Tighten until leak stops |
| Valve uses excessive air | Positioner stuck in open position | Clean or replace and readjust |
| | Diaphragm leaks | Replace it |
| | Piston ring leaks (for piston-operated valves) | Inspect and clean piston and ring, or replace ring |
| | Air-supply regulator stuck | Remove and clean or replace |
| | Loose air-line fittings | Tighten |
| Valve pressure gages don't work | No air supply | Check source |
| | Broken from overload | Replace them |
| Valve sluggish | Low air supply | Increase air supply |
| | Insufficient cushioning air (for springless valves) | Increase cushioning air |
| | Stem galled | Clean or replace |
| | Trim galled | Clean or replace |
| | Leaky diaphragm | Replace diaphragm |
| | Piston ring leaks (for piston-operated valves) | Inspect and replace ring |
| Valve goes to either end of stroke | Positioner mounting loose | Tighten mounting nuts |
| | Faulty piping | Check for leaks |
| | Incorrectly piped | Check piping diagrams |
| | Positioner out of adjustment | Check and reset |
| | Dirty positioner | Disassemble and clean |

OPERATORS' NOTEBOOK 82

# Get acquainted with your




## How valve works and other facts you should know

► THREE TYPES of high-pressure steam-drum safety valves in general use are: (1) jet flow (2) nozzle reaction (3) huddling chamber. Jet-flow type was covered in May 1954 Notebook 75, p 118-119; nozzle reaction in Nov 1954 Notebook 80, p 112-113.

**Huddling-chamber type.** In this valve the static pressure acting on the disk area causes initial opening. As valve pops, steam space within huddling chamber between seat and blowdown ring fills with steam and builds up more pressure on roof of disk holder. This temporary pressure increases the upward thrust against spring, causing disk and its holder to lift to full pop opening. After a predetermined pressure drop (blowdown), valve closes with a positive action by trapping steam on top of disk holder.

Blowdown is adjusted by raising or lowering the blowdown adjusting ring. Raising this ring increases blowdown; lowering decreases blowdown. Capacity figure as stamped on name plate and as required by the ASME Code for steam is 90% of valve's actual capacity when flowing at 3% overpressure.

Huddling-chamber-type valve is intended primarily for steam service but will work with gases. However, it is rarely used for such services as it doesn't have a closed bonnet. It's never used for liquid service.

**Precision-closing control.** With valve in open position and discharging, steam is bled into chamber *A* through three bleed holes *B* in roof of disk holder. Likewise, spindle overlap *C* rises to a predetermined position above the floating washer *D*. Area between floating washer and spindle is thereby increased by difference in two spindle diameters.

Under this condition, steam in chamber *A* escapes to the atmosphere through the secondary area formed by floating washer *D* and the spindle.

At instant of closing, spindle overlap *C* is so adjusted that it moves down into floating washer *D*, thereby effectively reducing escape of steam from chamber *A*.

Resulting momentary pressure buildup in chamber *A* produces a downward thrust in direction of spring loading. Combined thrust of pressure and spring loading results in tight, positive precision closing without wire drawing or dragging of seat surfaces.

*—Courtesy: Manning, Maxwell & Moore, Inc*

# huddling-chamber safety valve

BY STEVE ELONKA, *Associate Editor*

## HOW TO OVERHAUL

1 Remove cap and lever assembly, screw compression retainer against spring

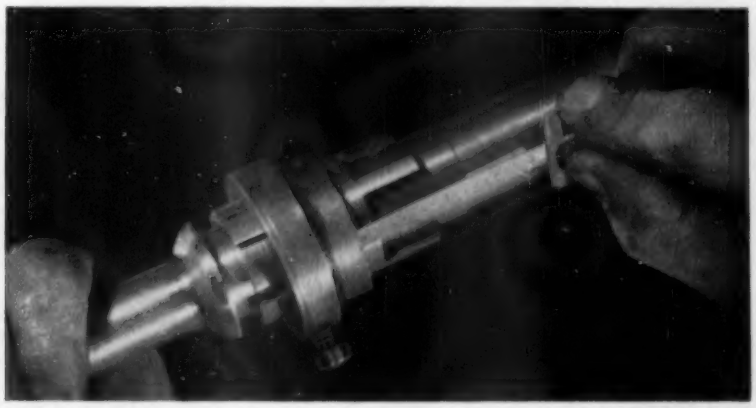
2 Remove bonnet, then lift the spindle guide and feather assembly from valve

3 Unscrew the feather (valve disk) from spindle. Hold spindle; turn the disk

4 Check blowdown's ring's position by screwing the ring up against disk

5 Insert power-driven abrasive-cloth recutting tool through feather guide

6 Regrind seat if necessary, using an electric drill, as shown, for speed

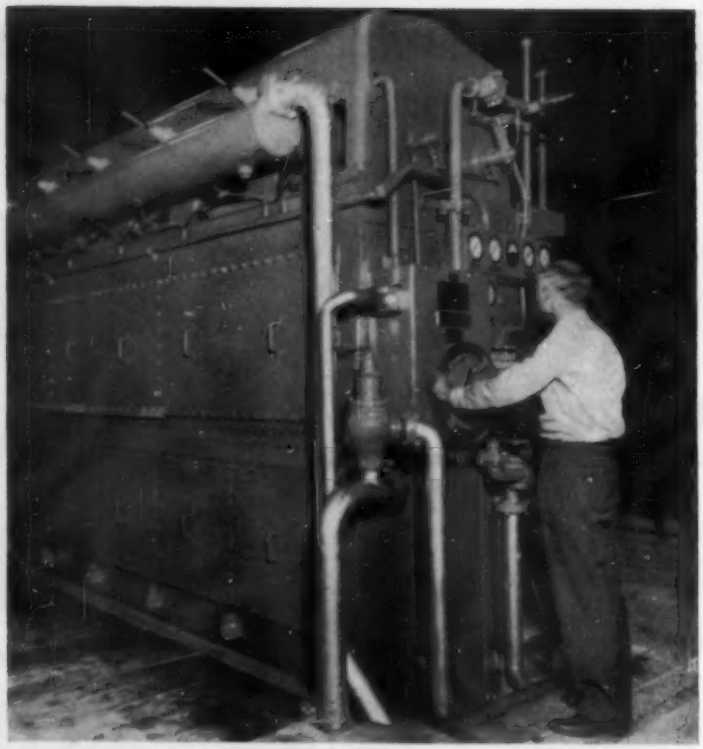


7 After grinding disk on seat, adjust the spindle overlap to keep the right back pressure on the disk for positive closing. Use the scale as illustrated here

FIRST OF A SERIES

by

RICK DENNING
*Marine Engineer*



**CORRECT TROUBLE-SHOOTING** prevents major diesel breakdowns

***You know it pays to keep your diesel installation in top operating condition. Here's first part of a handy check chart to . . .***

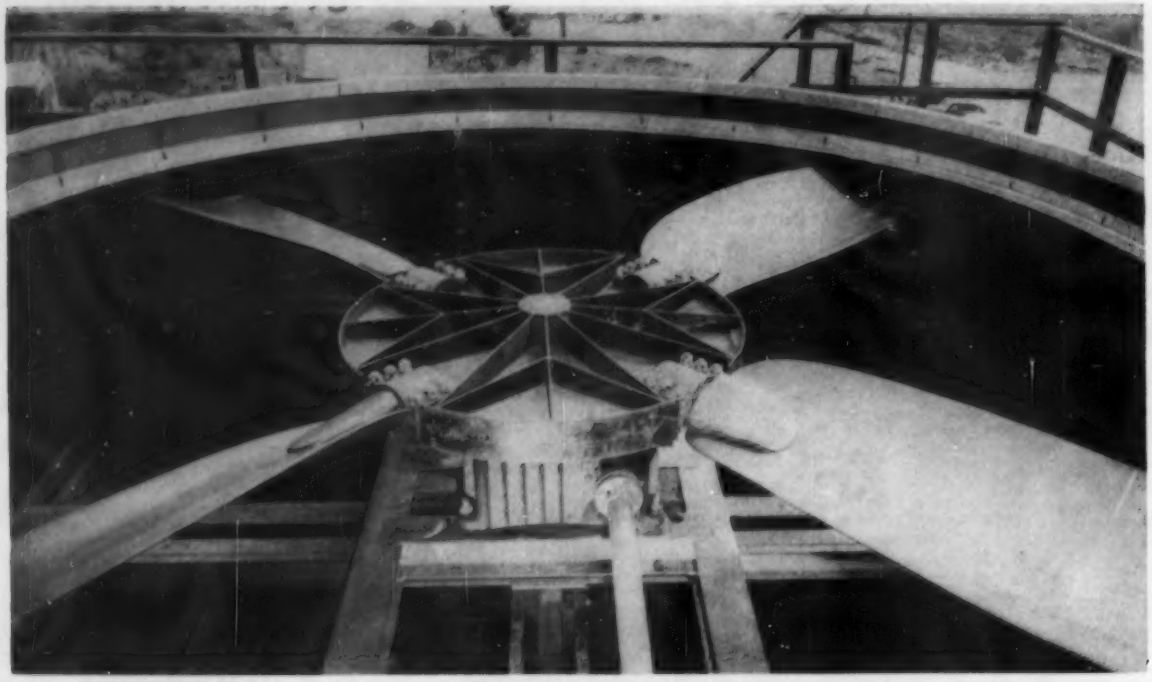
# Spot your diesel troubles in a hurry

| SYMPTOM | POSSIBLE CAUSES OF TROUBLE |
|---|---|
| STARTING AIR, OR MOTOR WON'T TURN ENGINE | 1 Starting-air pressure too low<br>2 Stuck-air starting valve<br>3 Inlet or exhaust valve stuck open<br>4 Improper timing of air starting valves<br>5 Clearance between starting cam and roller excessive or insufficient<br>6 Starting control out of adjustment or faulty<br>7 Valve closed in air-supply system<br>8 Locked starter gears due to:<br>(a) Foreign matter in gears<br>(b) Bent shaft<br>(c) Chipped or broken gear<br>9 Jam in driven machine<br>10 Tight bearings or pistons<br>11 Piston or bearing seizure<br>12 Crankshaft out of alignment<br>13 Starting battery discharged, weak; or loose or corroded terminals<br>14 Starting motor inoperative<br>15 Lubricating oil congealed<br>16 Water in cylinder due to:<br>(a) Leaky cylinder-head gasket<br>(b) Condensation<br>(c) Cracked cylinder block or head |
| EXCESSIVE SMOKE FROM ENGINE BREATHER | 1 Piston rings stuck or worn<br>2 Cracked piston<br>3 Pistons or cylinder liners worn<br>4 Leaky intake valves |

| SYMPTOM | POSSIBLE CAUSES OF TROUBLE |
|---|---|
| OVERHEATING | 1 Inadequate cooling-water circulation<br>(a) Sediment, scale or salt in water jackets<br>(b) Stoppage in cooling-water system<br>(c) Collapse of suction hose<br>(d) Faulty water pump<br>(e) Clogged or scaled heat exchanger<br>(f) Loose water-pump belt<br>(g) Insufficient cooling-water supply<br>(h) Improperly set bypass or other valve in water system<br>(i) Thermostat not opening<br>2 Fuel injection too late<br>3 Preignition of fuel—excessive carbon in cylinders<br>4 Improper valve timing<br>5 Clogged exhaust pipe or muffler<br>6 Overload<br>7 Excessive friction from tight bearings or pistons<br>8 Inadequate lube-oil supply—incorrect grade of lube oil<br>9 Dirty air filters<br>10 Blown head gasket<br>11 Cracked cylinder head or block |
| CYLINDER RELIEF VALVES POPPING | 1 Weak spring or improperly set relief valve<br>2 Abnormally high pressure in cylinder<br>(a) Overpriming of fuel lines<br>(b) Engine overloaded<br>(c) Cylinder overloaded—others cutting out<br>(d) Broken nozzle valve spring—leaky nozzle<br>(e) Improperly set fuel controls |

| SYMPTOM | POSSIBLE CAUSES OF TROUBLE |
|---|---|
| SMOKY EXHAUST | 1 Engine overloaded or overheated<br>2 Unequal delivery of fuel to cylinders. Cylinders carrying unequal load<br>3 Fuel injection too late<br>4 Poor grade of fuel; water or air in fuel<br>5 Broken or weak fuel-valve springs<br>6 Improper fuel-nozzle adjustment<br>7 Sticky, worn or leaky fuel nozzles<br>8 Misfiring on one or more cylinders<br>9 Excessive cylinder or exhaust-valve lubrication. Excessive lube-oil consumption<br>10 Low lube-oil pressure<br>11 Worn, stuck or broken piston rings<br>12 Obstructed exhaust piping<br>13 Low compression pressure<br>14 Restricted air intake<br>15 Overheated bearings |
| SLOWS DOWN OR STOPS | 1 Fuel supply insufficient or pressure low<br>2 Air, dirt or water in fuel system<br>3 Fouled fuel valves, filters, lines, nozzles<br>4 Faulty fuel-pump valves, sticking fuel-pump plungers, or leaky gaskets<br>5 Inoperative governor<br>6 Low injection-air pressure<br>7 Overload<br>8 Air-intake manifold obstructed<br>9 Clogged exhaust pipe or manifold<br>10 Piston or bearing seizure—lack of proper lubrication<br>11 Fuel oil too heavy or viscous<br>12 Low oil pressure or high engine temperature<br>13 Poor combustion of fuel |
| WON'T CARRY LOAD, LOSES POWER | 1 Governor regulation not properly adjusted<br>2 Faulty nozzle timing<br>3 One or more cylinders misfiring<br>4 Misalignment with load<br>5 Use of low heat-content fuel<br>6 Tight bearings on piston |
| LOW LUBE-OIL PRESSURE OR HIGH LUBE-OIL TEMP | 1 Inaccurate pressure gage or plugged gage lines<br>2 Air leak in sump pump connection<br>3 Air leak between oil-storage tank and pump<br>4 Thinning of oil by high oil temperature<br>5 Dilution of lube oil<br>6 Oil service tank running dry<br>7 Oil level in crankcase too low<br>8 Improper grade of lube oil<br>9 Clogged oil cooler<br>10 Clogged oil filters or screens<br>11 Loose or burned-out bearings<br>12 Faulty lube-oil pump<br>13 Faulty pressure regulating or relief valves<br>14 Leaky or broken oil line<br>15 Engine overheated |
| LOW FUEL PRESSURE, LOW FUEL DELIVERY TO CYLINDERS | 1 Fuel tank running dry<br>2 Clogged vent in fuel tank<br>3 Partially opened or closed valve in suction line<br>4 Clogged fuel filters or screens<br>5 Water in fuel freezing in cold weather<br>6 Congealed fuel in fuel lines<br>7 Air, dirt or water in fuel<br>8 Improper grade of fuel<br>9 Faulty fuel pump<br>10 Leaky pump-discharge valves<br>11 Leaky regulator valves<br>12 Leaky or open nozzle<br>13 Clogged nozzles<br>14 Sticking fuel-pump valves<br>15 Governor mechanism sticking<br>16 Broken gage or fuel line |

| SYMPTOM | POSSIBLE CAUSES OF TROUBLE |
|---|---|
| WON'T START OR HARD STARTING | 1 Cranking speed too slow<br>(a) Low starting-air pressure<br>(b) Starting valve held open<br>(c) Weak battery, loose connections<br>(d) Tight bearing or piston<br>2 Poor compression<br>3 Low fuel pressure<br>4 Lack of fuel or insufficient fuel delivery<br>5 Improper injection of fuel<br>(a) Fuel injection too late or too early<br>(b) Fuel-injection valves clogged<br>6 Starting control out of adjustment or faulty<br>7 Throttle not in starting position<br>8 Mechanism sticking<br>9 Water in cylinders or air box<br>10 Temperature too low<br>11 Overloaded<br>12 Clogged exhaust pipe or muffler<br>13 Accumulation of moisture, oil or dirt in starting air tank |
| WON'T COME UP TO SPEED | 1 Not enough fuel delivery<br>2 Low compression<br>3 Engine overloaded or overheated<br>4 Faulty governor action<br>5 Too late or too early combustion |
| EXCESSIVE LUBE-OIL USE | 1 Oil level in crankcase too high<br>2 High oil pressure<br>3 Oil leakage at crankshaft seal or external piping<br>4 Excessive bearing clearances<br>5 Overload<br>6 Improper grade of lube oil<br>7 Thinning of oil by overheating<br>8 Dilution of oil by fuel<br>9 Faulty oil seal in blower<br>10 Stuck or weak piston rings<br>11 Clogged oil drain holes in piston oil-ring grooves<br>12 Scraper edge of oil ring worn<br>13 Worn or scored cylinder walls, pistons and rings<br>14 Excessive suction on the crankcase and breather<br>15 Excessive speed, light-load operation and idling |
| LUBE-OIL DILUTION BY WATER | 1 Cracked coil in oil cooler<br>2 Faulty gasket at oil cooler<br>3 Faulty rubber-ring seal in liner<br>4 Leaky cylinder-head gasket<br>5 Cracked cylinder head or block<br>6 Sand hole in liner |
| MISFIRES | 1 Lack of sufficient fuel<br>2 Clogged nozzle<br>3 Sticking fuel-pump valve<br>4 Air, water, dirt in fuel lines or pump<br>5 Clogged filters or strainers<br>6 Valve clearance too close<br>7 Fuel-storage tank running dry<br>8 Priming valve open or leaky<br>9 Poor grade of fuel—low ignition quality, heavy or viscous fuel<br>10 Leaky or sticking nozzle<br>11 Low compression<br>12 Leaky head gasket<br>13 Water in cylinder |
| LUBE-OIL DILUTION BY FUEL | 1 Stuck piston rings<br>2 Leaky nozzle connections<br>3 Blown nozzle tip<br>4 Blown head gasket<br>5 Overload<br>6 Vacuum in crankcase due to faulty breather cap |



**1** Drive for induced-draft cooling-tower fan needs regular maintenance for best results. Every three months, see that the gear speed reducer and driver are carefully aligned, check the fan-blade angles and change the lubricating oil

# Are you giving your cooling-tower

***Weather extremes, hot wet air and unbalanced loads all act on cooling-tower fan drives. But you can get good service from them in spite of these severe conditions. Here's how***

By J E GUTZWILLER, *Assistant Chief Engineer*
*Standard Products Division, DeLaval Steam Turbine Co*

► To get good service from speed reducers driving cooling-tower fans, you need to understand the special factors involved in their design, as well as the proper methods of installation, lubrication and maintenance.

First, a word about arrangement of fan, speed reducer and driver in the common induced-draft cooling tower.

**The fan,** mounted in a horizontal plane, draws air through the tower and exhausts at the top. It mounts directly on the upward extended shaft of a right-angle speed reducer, which can be either a worm- or a bevel-gear type. An extended floating-shaft coupling connects gear-reducer input shaft to motor, keeping the driving motor outside the air stream. See Fig. 3.

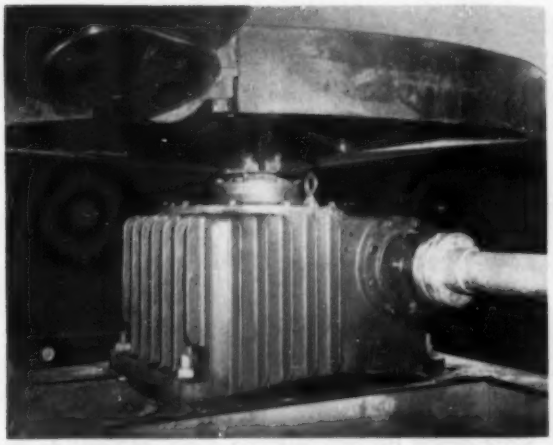
Power and speed required fall within well-defined limits. Most common driver is a 1750-rpm induction motor, 5 to 75 hp. Fan speeds range from 150 to 550 rpm, requiring reductions from 3:1 to 12:1. Other drivers sometimes employed are gasoline engines, steam turbines, hydraulic motors.

Fan horsepower is influenced by velocity, particularly when a variable-speed drive is involved. Power required varies approximately with the cube of fan speed. Blade-angle setting also affects power consumption. Don't increase the fanblade angle without getting the approval of cooling-tower manufacturer. This will avoid trouble.

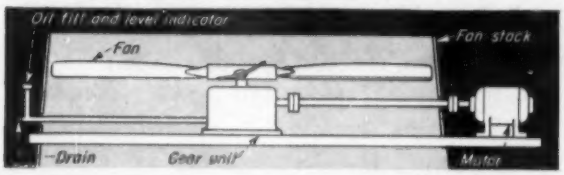
Other factors that vary with the weather are wind velocity and direction, and air temperature. Colder, denser air increases fan horsepower.

**Ambient conditions** for the gear reducer are extremely severe. It's right in the air stream, and exposed to the weather. Air exhausted from the tower is near the saturation point at temperatures from 75 to 120 F. When equipment is not operating, exposure of gear drive to weather can be particularly damaging. Cold starts in below-freezing weather are common in winter.

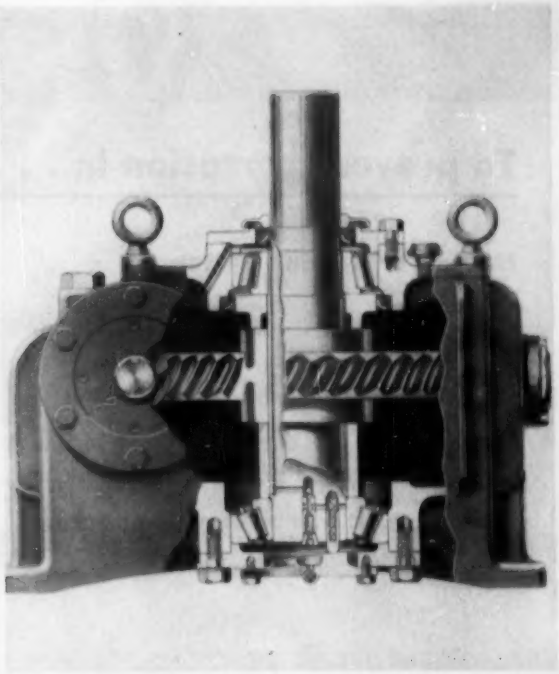
**Bearings and gears** must absorb loads imposed by the fan mounted directly on the gear-reducer output shaft. There is also a downward-thrust load caused by fan weight and aerodynamic reaction. And loads of unknown magnitude may exist because of unbalance in either the fan itself or the aerodynamic forces acting on the fan. Inconsistent settings of the angles for individual fan blades, or the presence of structural members in the air stream near the suction side of the fan can cause aerodynamic un-



**2** Speed reducer must use the proper grade of oil. Follow manufacturer's recommendations. Check oil level weekly




**3** Common arrangement of fan, gears and motor. Drain off accumulations of moisture in the oil reservoir every month



**4** Special worm-gear unit has flinger and shaft seal to keep moisture out, plus pump to supply oil to the upper bearing

# fan drives the right attention?

balance, resulting in unknown loads.

Speed reducer must be designed to meet these conditions. Fan-shaft bearings should be generously proportioned to carry unbalanced radial and thrust forces. A rigid case construction, heavily ribbed to resist deflection, is also required. Bearings and gears must be adequately protected against corrosion by shaft seals and suitable lubrication systems.

Worm-gear unit shown, Fig. 4, is specially designed for cooling-tower service. Upper bearing on fan shaft is above oil reservoir, and would normally be the most vulnerable to corrosion, especially during shutdown. But a flinger and shaft seal protect against entrance of moisture at the top, and a positive-displacement pump supplies oil through the shaft to this bearing.

Below the bearing, an additional seal forms an oil reservoir that is continuously refilled during operation. During shutdown, oil retained around the bearing protects against corrosion.

An auxiliary drain below the fan-shaft lower bearing permits periodically draining off water that might accumulate in lowest point of the reservoir.

**Installation.** To insure proper operation of the equipment, it must be correctly installed. Cooling-tower drive equipment requires special consideration because of the structure and type of loading involved. Wood construction commonly used for towers is subject to changes in dimension. This may adversely affect equipment alignment. Particular differences may be noted between wet and dry state.

Best practice is to mount gear reducer and driver on common structural steel members. Bolt gear reducers to supporting members, with bolts secured by double nuts or other approved locking means. After aligning couplings, dowel gear unit to supporting members, or fix in the proper horizontal position with jack bolts. This will resist the loosening effect of vibration and the twisting effect of fan reaction.

Alignment may change after water goes on the tower; recheck within a week after start of operation.

**Lubrication.** Be sure to use the proper grade of lubricant, following gear manufacturer's recommendations. As speed reducer is directly in the saturated air stream, it's advisable to change lubricant every three months.

Check oil level in the gearbox at least once a week. Speed reducer is in a rather inaccessible position and operation is often continuous. It's easier to check the level if you bring the indicator and oil fill and drain connections to a more convenient location, Fig. 3. No matter what type of indicator you use, operation must have stopped for several minutes before you can get an

(*Continued on page* 202)

**Modernization Awards**

**To learn how you can win recognition for your accomplishments, see pp 80-81.**

## To prevent corrosion in . . .

**Hot-water heating system:**

Make water slightly alkaline on the first filling of the system piping

Keep phenolphthalein alkalinity of 100 ppm in the system at all times

Don't empty system during summer season

Prevent contact with air as much as possible

Keep system leaks to a minimum

**Low-pressure-steam heating system:**

Prevent air leakage into system

Keep close check against excess loss of water from system

Blow down boilers in large plant regularly

For systems operating below 5 psig, keep water alkaline with caustic soda

Have system checked by water expert

# Stop losing your heating-system dollars to corrosion

***Service interruption and large expenses result from failure of parts in a steam heating system. Proper water treatment and a tight system slow down internal corrosion losses, care in pipe laying checks external attack. Oxygen and carbon dioxide are the biggest trouble makers in heating systems***

► Corrosion in your heating system can be stopped. Protection against attack starts with proper design and installation of the system. Right water treatment and continuous maintenance complete the needs for trouble-free operation.

Some of the main points to keep in mind for the various types of heating plants are outlined in table above. Two basic items pertain to all three: keep use of makeup water as low as possible and hold contact of water or steam with air to a minimum. Closed hot-water system has an advantage over the others in easier control of corrosion.

**Hot-water heating systems.** Little corrosion occurs in smaller hot-water plants. Table above shows how to prevent corrosion in any size system. Let's consider the items point by point and amplify them as needed.

On first filling the system, make the water slightly alkaline with caustic soda or sodium silicate. Once filled, the water should not be drawn from the system unless absolutely necessary. This keeps contact of water in system with air as low as design permits. And after original free oxygen is used up, cor-

**District-steam heating system:**

Keep close control of tightness of system, treatment of return water, amount and quality of makeup water

Lay return pipes so they drain properly

Prevent external corrosion by laying return pipe in dry places—never in contact with cinder fill. Always insulate pipe where it goes through concrete

Don't use soda ash for boilers operating above 5 psig

Get expert advice from feedwater consultant

rosion practically comes to standstill. Iron still dissolves, though, until water becomes saturated with ferrous hydroxide. Initial alkalinity reduces this last action.

Place water lines to hotwell below water level to cut down disturbance and to keep air contact to a minimum. A steam blanket over the hotwell surface can be used to protect water from air. If rest of system is tight, there is no chance for contamination from outside source except through small amounts of makeup, and plant will remain free from internal corrosion.

**Low-pressure steam heating system.** Small plants need little or no water treatment if system is tight, as makeup would be relatively small. But it is difficult to get a tight system in actual practice. And corrosion damage is proportional to amount of air getting into system. To protect your system, keep these leaks to a minimum by continuous maintenance.

Most raw water contains oxygen and carbon dioxide. Continuous loss of water from the boiler through leaks calls for steady supply of makeup. So if water goes to boiler untreated, oxygen and carbon dioxide enter the system at a rate dependent on amount of makeup. Corrosion from both gases results. Stopping leaks in system would be one way to solve this problem.

Use sodium sulfite to take care of oxygen in the return water. This forms sodium sulfate, harmless in the absence of oxygen if water is slightly alkaline. For large systems operating below 5 psig, convert free and half-bound carbon dioxide to normal carbonates by keeping water alkaline with caustic soda. Test water with phenolphthalein indicator, which gives definite pink color when hydrate alkalinity is present.

Services of a feedwater consultant often save money for the building owner. His tests of water and steam and his resulting advice as to condition of system and needed water treatment usually pay off. Tests should include amount of free oxygen and carbon dioxide, and the pH value.

**District steam heating system.** Use boiler-water treatment to prevent contamination of the steam. Most attacks from impure steam occur in consumers' return lines and in auxiliary apparatus.

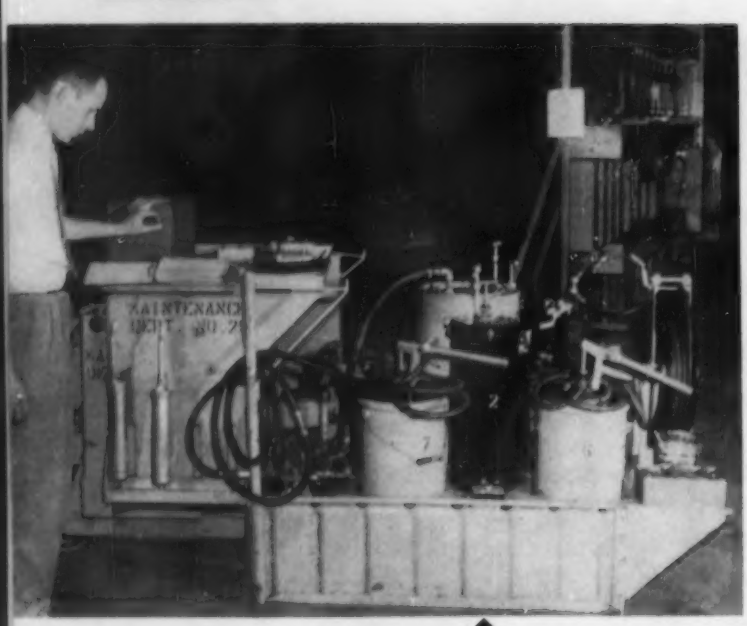
Lay supply and return lines so leakage from one won't cause external corrosion in the other. Wet insulating material makes galvanic attack possible and, if stray currents are present, allows electrolysis to proceed. Lay return pipe in dry places. Cinder fill has acid action and so should never be put in contact with pipes unless acidity is neutralized with lime mortar. Insulate pipes from direct contact with concrete. Moist concrete is a good electrical conductor.

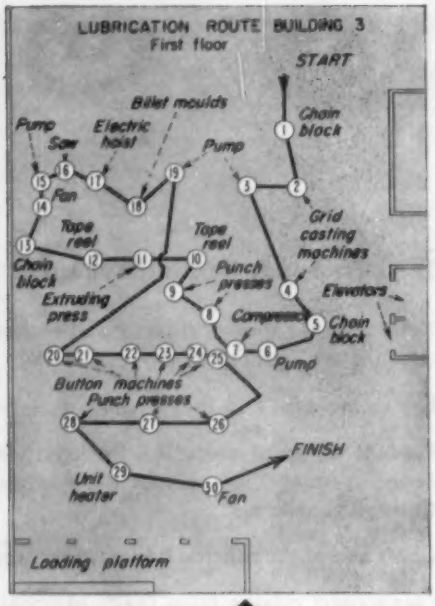
Supply and return lines are often placed in vitrified tile with inspection openings. This casing must prevent ground water from entering and thereby injuring the insulation. Installing pipe tunnels is another way of laying the pipes. Recently, there has been some success with water-resisting insulating concrete. Here the concrete both supports and insulates the pipes.

Lay return lines so they drain properly. Condensate should not lie in contact with metal for any length of time.

Above 5 psig, soda ash decomposes rapidly to form caustic soda and carbon dioxide. For this reason, it should not be present in the treated feedwater for district-steam-heating boilers operating at pressures above 5-psig limit.

LUBRICATION






## We use this lube rig...on a careful routing...

# We've doubled life of some equipment

**Stalling on overdue streamlining of your lubrication methods? Then adopt Exide's successful approach: right from the lube survey to the molding of 'oilers' into 'lubrication mechanics'**

By S J HAAS, *Lubrication Engineer, The Electric Storage Battery Company*

► PLANT LUBRICATION in years past generally came under the wing of individual departments. This held for our company as well as industry as a whole. Our records show that some departments did an excellent job while others were either over-enthusiastic or outright lax. And our Crescentville plant in Philadelphia is big, containing more than 800,000 sq ft of working area.

Some time back we started a fresh approach to our lube needs. First step in the plan was a complete lubrication survey. This was a thorough and realistic job, made with the help of one of the major oil suppliers. We brought to light some interesting facts:

*Fact 1*: Our plant was using 23 different oils and 13 different greases.

*Fact 2*: Grease fittings ran the full line of manufacturers and models. Often a single machine was equipped with several different fittings.

*Fact 3*: The plant had gathered a sizable collection of lube-application equipment.

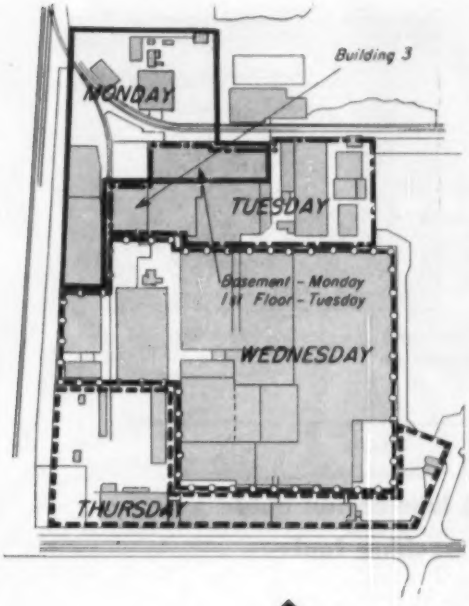
*Fact 4*: As in other plants, feast or famine lubrication was quite common. Also, some machines were generally well lubricated, but probing ferreted out several unexposed fittings that were completely ignored.

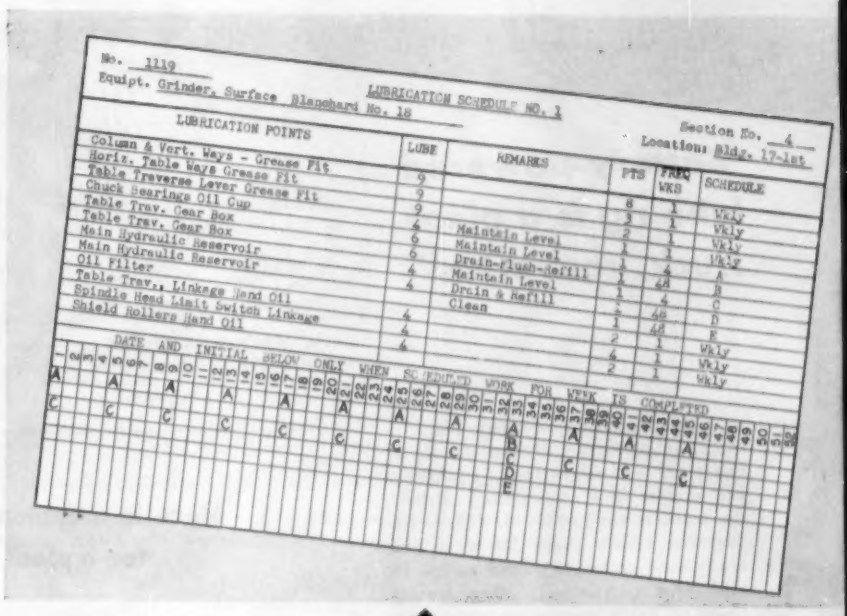
*Fact 5*: Where open-pail-and-paddle method was used for dispensing grease and filling grease guns, grease pails were often discarded before being fully emptied because of over-contamination. And oils were often transferred from the spotless refinery drums to containers, introducing possible contaminants.

Survey results pointed out quite clearly that we needed: (1) a well-defined organization (2) standardization of lubricants and application equipment (3) better dispensing and application techniques (4) a system of lube scheduling, manpower training and follow-up.

**What we did.** Following the lube standardization that is being adopted in most well-operated plants, we trimmed the number of lubricants back to 12 oils and 3 greases. And these we adopted as standard for the plant. Hydraulic-type grease fittings were accepted as the standard. We settled for the hydraulic-type fitting because it adapted well to operating conditions, was easiest to clean, made the quickest coupling, was less expensive and the type most often supplied with new machinery. Now all grease guns fit all grease fittings without adapters.

But that was just a starter. A lubrication organization was set up so all lube work, with the possible exception of daily squirt-can oiling, was taken out of the hands of individual departments and pegged to a separate section of the Maintenance Dept. We avoid the term



No. 1119
Equipt. Grinder, Surface Blanchard No. 18
LUBRICATION SCHEDULE NO. 3
Section No. 4
Location: Bldg. 17-1st

| LUBRICATION POINTS | LUBE | REMARKS | PTS | FREQ WKS | SCHEDULE |
|---|---|---|---|---|---|
| Column & Vert. Ways - Grease Fit | 9 | | 8 | 1 | Wkly |
| Horiz. Table Ways Grease Fit | 9 | | 9 | 1 | Wkly |
| Table Traverse Lever Grease Fit | 9 | | 2 | 1 | Wkly |
| Chuck Bearings Oil Cup | 4 | Maintain Level | 1 | 1 | Wkly |
| Table Trav. Gear Box | 6 | Maintain Level | 1 | 1 | Wkly |
| Main Hydraulic Reservoir | 6 | Drain-flush-refill | 1 | 4 | A |
| Main Hydraulic Reservoir | 4 | Maintain Level | 1 | 48 | B |
| Oil Filter | 4 | Drain & Refill | 1 | 4 | C |
| Table Trav., Linkage Hand Oil | | Clean | 1 | 48 | D |
| Spindle Head Limit Switch Linkage | 4 | | 1 | 48 | E |
| Shield Rollers Hand Oil | 4 | | 4 | 1 | Wkly |
| | 4 | | 2 | 1 | Wkly |
| | | | 2 | 1 | Wkly |

DATE AND INITIAL ACTION ONLY WHEN SCHEDULED WORK FOR WEEK IS COMPLETED

| Jan | Feb | Mar | Apr | May | June | July | Aug | Sept | Oct | Nov | Dec |
|---|---|---|---|---|---|---|---|---|---|---|---|
| A | A | A | A | A | A | A | A | A | A | A | A |
| C | C | C | C | C | C | C | C | C | C | C | C |
| | | | | | | | | | | | |

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52

A
B
C
D
E

## ...throughout the plant...keep records, and...

# with our planned lubrication program

"oiler," much preferring the title Lubrication Mechanic. To land such a job a man needed the skills and experience of a first-class millwright.

We set up a lube-training program for men accepted for this position. It became a sound, highly practical plan, even though carried out informally. Subjects covered were: (1) lubricant types and their application (2) sleeve and rolling-contact bearing lubrication theory (3) gear lubrication (4) operation and installation of various pieces of lube-dispensing equipment.

While working up a programing and scheduling plan, we corrected some of the sore spots in the existing lubrication scheme. Two steps made a big difference: Overhaul of existing lube-service equipment and buying of loading pumps for grease guns. These alone trimmed down waste and contamination. Next move was to install constant-level oilers on all ring-oiled bearings. This fact resulted in better lubrication plus reduction of oil waste. Other types of semi-automatic lube-dispensing equipment followed.

**Lube scheduling.** Specifications were prepared covering each of our standard oils and greases. From that point on, all lubricants were referred to by their Electric Storage Battery Co specification number. This arrangement permitted changing lube brands without upsetting our schedules or revising the lubricant check list.

A continuous schedule and check list was settled on with a lube check list made up for each plant machine. These lists showed the part to be lubricated, ESB Co specification number for the lubricant, number of points to be lubricated, how often, *see sample form above.* This card form is supplemented by a more complete lube-specification sheet, *see next page.*

For lube-scheduling purposes, we divided the plant into four sections each containing about one-quarter of the lubrication work. Each such quarter represented one day's work in the weekly schedule. We had several reasons for adopting a 4-day work schedule: (1) Holidays would trim a 5-day schedule back to four about six times annually. (2) Lubrication mechanics now have time to maintain their equipment and stock. (3) If trouble crops up during regular scheduled rounds, the freed day provides a chance to catch up without running over into next week's schedule.

To further simplify scheduling, the complete lube cycle rotates on a 48-week year. A lubrication calendar was prepared to indicate the lube schedule-week number as opposed to regular calendar weeks. Our schedule skips the plant's annual 2-week vacation shutdown.

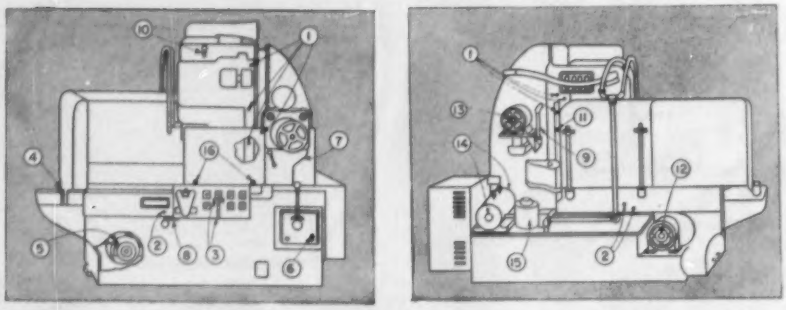
Floor plans were sketched to show machinery and equipment positions using standard abbreviations and plant inventory number. Routes were laid out on these sketches and machine check lists for the area were placed in order according to the route. All check lists were bound in a *Masonite*-covered binder, which opens flat and mounts in a bracket on the lubrication truck.

A newly established lubrication shop became the storage and maintenance area for lubricants and dispensing equipment. Drum racks, storage cabinets, a work bench and lubricant-dispensing equipment were installed. Several coats of gray paint were applied to the concrete floor and all lubrication-dispensing equipment. This improved the general appearance and lightened housekeeping.

**Lubrication truck** was designed and built in our own shops. The nucleus

PLANNED LUBRICATION continued

## 'Battery-powered lube rig is a plant truck, converted'



**THESE MACHINE SKETCHES** accompany lubrication mechanic's check list and stay with the lube rig. Every point requiring lubrication is listed for each plant machine

is a plant battery-powered platform truck. (ED. NOTE: *Design details of this truck and its complete equipment will appear in a later issue.*) Briefly, the truck is equipped with (1) power-operated grease pump for most generally used grease (2) hand pumps for oils, gear compounds, other greases. Guns to apply grease, oil cans, tools, fittings are also provided.

Truck is loaded on Friday of each week for the following 4-day cycle. It starts out Monday morning to complete the first quarter of the weekly schedule. On Tuesday the second quarter is wrapped up, Wednesday the third, and Thursday the last fourth. As per plan, Friday is generally the day for installing and maintaining lubrication equipment, servicing the lubricant stock and preparing the truck for the following week. This plan also comes in handy if trouble develops or a holiday interrupts the normal work week.

**Follow-up** on my part on the effectiveness of the program is done in two ways: (1) Schedule coverage is checked from punchings on lube schedule cards. (2) Spot checking of machines is made regularly along with speaking to department foremen. To date the program includes about 5000 pieces of equipment and motors with an average of four lubrication points each.

In looking over the results attained so far we can point to a marked decrease in machine failures and a sizable reduction in lubricant cost. Case in point: conveyor chain life upped 100%.

Some of the side benefits we found include better housekeeping and improved plant safety. Fire hazards were reduced. And there is another factor, hard to evaluate but growing in significance as our lubrication program gathers steam: the spotting of generally faulty mechanical conditions by our lubrication mechanics. They have been most effective in finding troublesome conditions that can be corrected before they reach the critical stage.

### Here is a typical lubrication guide for a plant machine tool

**Date:** *January 4, 1955* **Equipment:** *Blanchard Grinder No. 18*

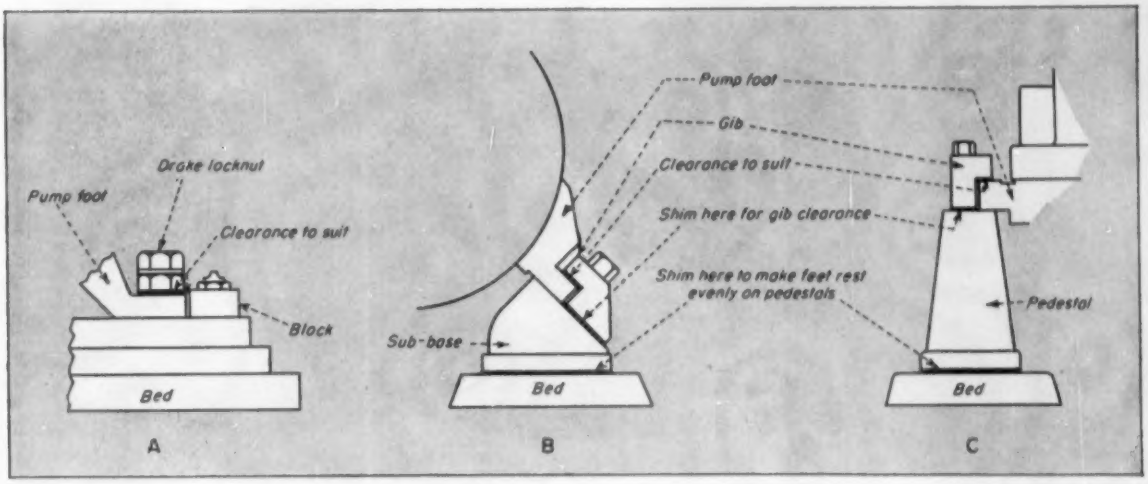
| *Item* | *Fittings* | *Points* | *Lube No.* | *How often* |
|---|---|---|---|---|
| 1. Column, vertical ways | Grease | 8 | 9 | Weekly |
| 2. Horizontal table ways | Grease | 3 | 9 | Weekly |
| 3. Table traverse lever | Grease | 2 | 9 | Weekly |
| 4. Chuck bearings | Oil cup[1] | 1 | 4 | Weekly |
| 5. Table traverse gears | Reservoir[2] | 1 | 6 | Check monthly, refill annually |
| 6. Main hydraulic system | Reservoir[3] | 1 | 4 | Check monthly, refill annually |
| 7. Oil filter | None | 1 | None | Clean, replace annually |
| 8. Table traverse linkage | Hand oil | 2 | 4 | Weekly |
| 9. Spindle-limit-sw links | Hand oil | 4 | 4 | Weekly |
| 10. Spindle-drive motor, top bearing #1120 | Oil cup | 1 | 2 | Check weekly, refill annually |
| 11. Spindle-drive motor, bottom bearing #1120 | Grease | 1 | 9 | 12 weeks |
| 12. Table, traverse motor, bearings #1121 | Prepacked | 2 | 9 | Clean, repack every 5 years |
| 13. Head-raising motor, bearings #1122 | Prepacked | 2 | 9 | Clean, repack every 5 years |
| 14. Chuck rotation motor, bearings #1123 | Grease | 2 | 9 | 24 weeks |
| 15. Coolant pump motor, bearings #1124 | Prepacked | 2 | 9 | Clean, repack every 5 years |
| 16. Water shield rollers | Hand oil | 2 | 4 | Weekly |

[1]Maintain oil level ¼-in. below top of cup.

[2]Maintain level on oil gage.

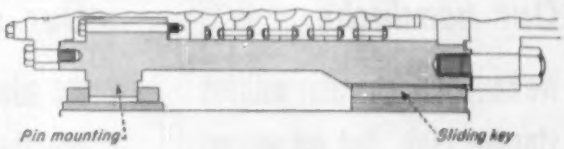
[3]Maintain level on oil-sight gage. After draining and refilling reservoir, operate machine for a few minutes, then add oil to proper level.

PUMPS




1 Locknut *A* is used to prevent vertical movement in some types of smaller pumps. Arrangement *B* is for high-pressure high-temperature barrel-type pumps. Pedestal-mounted horizontally split pumps can have a vertical gib, as is shown at *C*

***For dependable output at all times, follow these practical hints to . . .***




2 Pin mounting at left end of this barrel-type pump allows for radial expansion; slide key at right, horizontal expansion

# Adjust hot-liquid pump casings right

► CENTRIFUGAL PUMPS handling hot liquids expand when brought from room to operating temperature. To permit expansion and contraction without distortion, the casing feet are often designed to slide horizontally.

**Small pumps.** In one design, Fig. 1A, a Drake locknut prevents vertical movement, while blocks at the sides of the feet control sidewise movement. To install this type of slide, tighten the lower half of the locknut until the recommended clearance between nut and foot is secured. On some pumps this is 0.002 in., but it varies somewhat from one manufacturer to another.

Lock in place by pulling down the upper half of the nut. Check to see that clearance between foot and block is correct. This is often 0.002 in., but it varies with make.

**Barrel pumps.** In some designs, Fig. 1B, the plane of the feet is at 45 degrees to the vertical center line of the pump. The gib blocks may be fitted with aligning screws, which are used only while the pump is being aligned. After it is aligned, these screws are backed off.

Do not use the gibs to draw the feet into position. If they do not rest squarely on the pedestal, adjust by inserting shims between pedestal bottom and the bedplate pad. Gib blocks need be drawn down only moderately tight because excessive tightening serves no purpose.

Clearance between top of foot and under side of gib is usually 0.002 in., depending on make, operating temperature, etc.

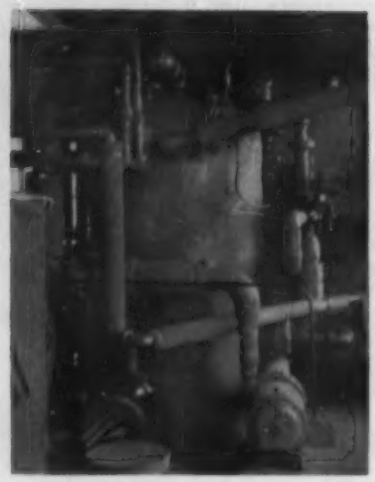
**Pin-and-key.** This design, Fig. 2, is for barrel-type pumps and has a pin at one end for free radial expansion, while horizontal movement is permitted by a sliding key at the other end.

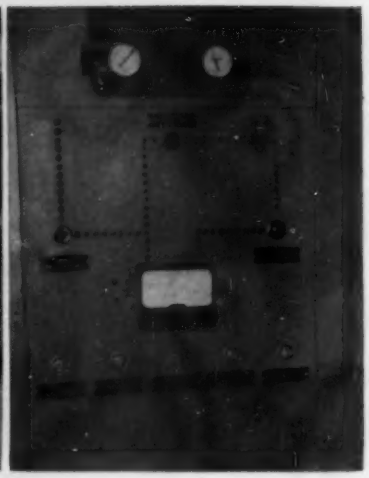
In other barrel-pump designs, the unit is supported at the horizontal center line and pinned at the discharge end, with the suction end free to slide in a guide. Radial expansion occurs about the horizontal center line of the pump, equally all around.

**Horizontally split pumps.** Here, Fig. 1C, a gib-and-pedestal arrangement may also be used. As with barrel-type pumps, a clearance of 0.002 in. between gib underside and foot top surface is often recommended. Shim gib block and pedestal, if necessary, to obtain the desired clearance.

**Dowels.** Some builders suggest doweling the casing or feet at both ends of the pump. Exact location of dowels varies from one make to another so consult the manufacturer when in doubt. Many hot-liquid pumps are doweled at the thrust-bearing end, though some are bolted. Dowels at the other end, if used, are fitted to allow the casing to expand when heated.

Never dowel until after a final check of alignment under actual operating conditions. Taper of the usual dowel is ¼ inch per foot. After drilling dowel holes, ream with a tapered reamer of a size corresponding to the dowel number. Dowels should sink well into the bedplate, but extend above pump and driver feet. The feet of some pumps are doweled in the factory, saving you this job when the pump is being installed.





## *Our headache*

**We bought a deaerator without storage tank. But balancing was tough under varying loads**

## *Our solution*

**We adopted electrical control. Entire system now operated by 2 microswitches, left. Control-panel lamps, right, show complete water flow cycle**

# *Electrical control adapts tankless*

By L W FITZPATRICK, *Chief Engineer*
*Dept of Corrections, Jefferson City, Mo.*

► ONE OF OUR PLANTS has a fluctuating steam load that required the operator to repeatedly balance water input or deaeration steam. It just wouldn't remain balanced more than 90 minutes at a clip.

**Electrical controls.** We went ahead and built our own control system. We started by discarding float-controlled flow valve but held on to the float lever arm. Briefly, the entire new system is controlled by two microswitches, which make contact through a thin metal plate welded to the float-lever arm. Top switch, drawing on facing page, serves as a combination limit and return-condensate bypass control. Lower switch starts auxiliary pump to balance out water demand.

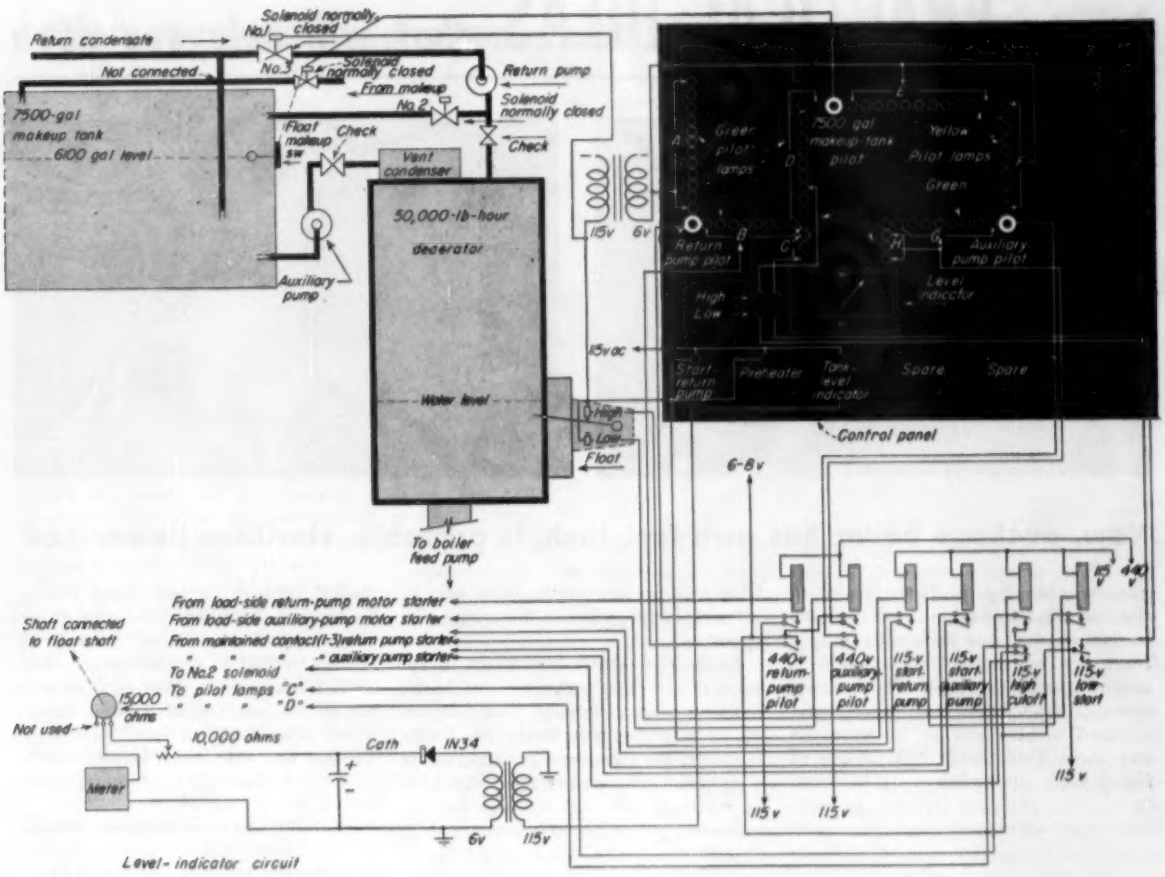
Main control panel, alongside operator's desk, shows entire waterflow cycle. Small pilot lamps present an illuminated flow pattern, whether to makeup tank or preheater, and show how many pumps are operating. Level indicator meter, simulating the preheater body on control board, is an auxiliary indicator of level and discharge rate of the preheater. It is a 1-ma instrument. Small set of pilot lamps to left of meter shows the on-off position of the two microswitches at preheater.

**Pilot lamps** are regular 6- 8-v screw-base miniature bulbs rated 3000 hours. Stepdown transformers are purposely overloaded to hold voltage to about 5 v, thereby extending lamp life. Panel holes were drilled on 1-in. centers for close lamp mounting. We included several spare relays and switches so future controls can be added to integrate our continuous blowdown system and for possible additions to our feedwater system. Spare relays will also be a ready replacement source when trouble develops.

Deaerator is a Graver 50,000-lb-hr unit without the usual storage tank. Tank was not included because of limited space. It has a 2-minute-peak water-storage capacity. Unit has topped 56,000 lb hr, still producing low oxygen-content water to the boiler-feed pumps, 30 feet below on the plant floor.

We eliminated the overflow system from the deaerator since water level is so closely balanced electrically that it cannot overflow because of the fast relay and solenoid operation.

**How it works.** All hot-water returns enter the makeup tank near the pump suction takeoff. This keeps hot water at the operating makeup-tank end, continually giving off concentrated hot water over a group of returns running




# deaerator to swing-loads

down the length of 7500-gal makeup-tank top. Normal tank temperatures at this end average 185 to 195 F.

On high-water demands or slowed condensate returns, the auxiliary heater pump starts as the lower microswitch closes and both pumps are feeding water to the preheater. Upon reaching its level, the lower switch opens, closing down the auxiliary pump. At the same time, the return-condensate pump continues until the top level is again reached; then the return condensate bypasses again to the makeup tank.

During operation the return-condensate pump is continually tossing water to the preheater except during a surge when the preheater would reach level quickly. The auxiliary pump usually cycles once to five starts of the return-condensate cycle.

**Makeup-tank** level is automatically controlled at about the 6100-gal level through a float-switch connected directly to solenoid No. 3. A pilot light shows when makeup tank is taking on water.

Steam to the deaerator is closely regulated by a 3-in. 15-psi regulator taking from the main plant's 125-psi header. When water enters the preheater, steam pressure drops to between 4 and 5 psi. An auxiliary 1-in. regulator, set at 220 F, automatically smooths off temperature variations, delivering constant temperature-controlled deaerator effluent.

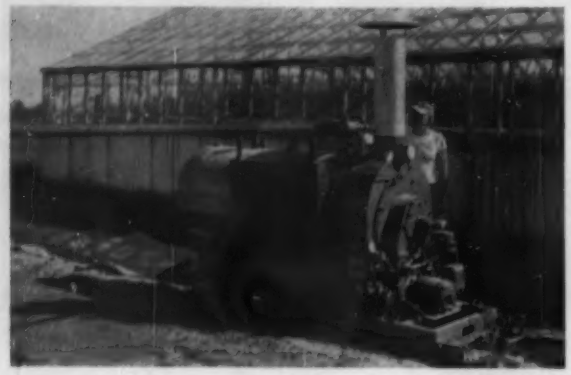
The No. 1 solenoid is controlled from the preheater switch on the control panel. Its purpose is to completely close off the return-condensate system to the deaerator when shutting down. This allows the returns to flow by gravity to the makeup tank and avoids direct flow to the deaerator and flooding.

## Here's how our new control scheme works

Actual operation of our new setup is quite simple. When the deaerator high cutoff switch opens, solenoid valve No. 2 closes, sending return condensate to the deaerator. Deaerator-tank level builds up and cutoff closes. This action reopens solenoid No. 2, routing water to makeup tank and insuring a constant-return system while making maximum use of return condensate.

Because of this flow circuit, it is possible for the same distilled water to go to the boilers from four to six times each hour, sharply reducing former blowdown rate. A takeoff was made in return line near the front tank end to eliminate steam whine through the pump from flashed condensate returns.

# *Timely* PRACTICAL IDEAS *that will help you do a*

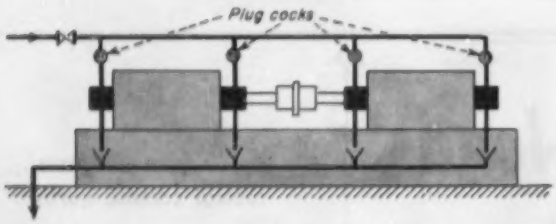


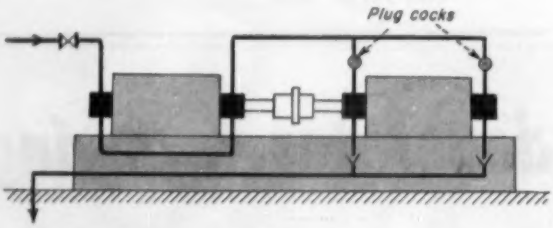
## Now, package boiler has own fuel tank, is portable, sterilizes flower bed

FLORIST USES h-p packaged boiler to sterilize soil. Standard unit was mounted on 8-in. channel-iron skids with ski-type front and rear. That helped shift it around greenhouse area. Photo shows special L-shaped fuel tank permanently attached to generator so it carries its own fuel. Tank holds 100 gallons of No. 2 fuel. Short flue is 24 in. high, 18-gage galvanized pipe, high enough to vent fumes without disturbing the operators.

Inside view shows how steam is applied to bed from generator outside the building. Steam hose is used because it's more flexible than steel pipe. Boiler is pulled down between greenhouses by a tractor, window raised and steam hose passed through to bed being treated. In treating this inside bed, a 100-ft section is sterilized. Canvas cover is extended to floor to sterilize entire structure, killing weeds, grass or insects on the floor. Sterilization process doesn't affect other beds on left. This shows one use for these small boilers.

*—Courtesy, Cyclotherm Corp.*




## Here's my idea on Pef's September headache

PEF'S PIPING HOOK-UP is simple but, as pointed out by the editor, last bearing will probably run hottest and determine flow to other bearings regardless of their needs. Another disadvantage is that sediment may plug lines, knocking out all bearings.

My preference is for cooling each bearing individually, first sketch. Each bearing should have its own plugcock and funnel located for observation. It's a nuisance to run to machine's end and check different flows going to one common funnel. I would set flow to each bearing for outlet temperature of about 90 F, then use shutoff valve when shutting down machine. I don't believe you'll use any more water than a series hook-up if flows are carefully adjusted.

My second choice, sketch, is to have motor bearings in series and pump bearings adjusted individually.

W J STEINERT
*Fresh Meadows, N. Y.*

## Sealing furnace door stops air leaks

KEEPING a boiler free from air leaks is a never-ending battle, but the following keeps our draft within desired limits.

Full-length doors on front of our watertube boiler had numerous air leaks. Doors were opened only on annual boiler inspection. After that we now seal them with asphalt furnace-cement.

Door to combustion chamber on side of boiler also had tendency to let in air to the furnace. We bricked in opening with fire brick, and plastered it over on the outside with high-temperature insulating cement. This also keeps door from overheating. Both jobs can be done in an hour. They give us better draft for the coming year.

R J ANDERSON *St. Paul, Minn.*

# better operating and maintenance job

STEVE ELONKA, *Associate Editor*

## We stopped wasting diesel cooling water

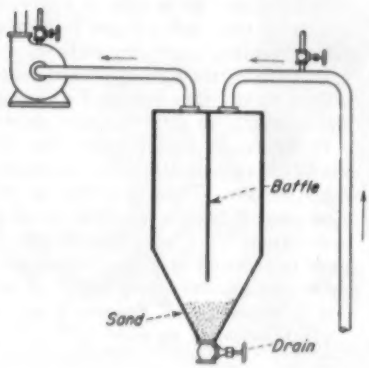
EXPANSION TANK for our diesel-engine cooling system has a pressure valve set to open at 6 psi. But this is on discharge side of water pump, and discharge pressure, added to that normally created by expansion of coolant, often opens valve prematurely, allowing several gallons to escape.

We removed pressure valve, inserted a ¼-in. nipple and globe valve to bleed off air. Then we hung an 8-gallon water tank from roof and connected it to return line from heat exchanger. Practically no water is lost now—this is important because we use rust inhibitor. Also, raw water needed to cool engine is only a fraction of what it was.

Here's how we figured. Tank is hung 15 ft above highest point on engine, which is roughly 6 psi; but since net head on suction side of pump is slightly less, tank probably could be hung lower if headroom were limited. As to tank size, we estimated cooling system contains about 100 gallons, and expands about 3% from 100 to 180 F.

Since we can add water by a hose connection to our closed circuit without taking cap off expansion tank, we carry a few feet of head when cold to eliminate any possibility of vacuum in the system when it is running.

A DOUGLAS ALLEN *Aspen, Colo.*




## Keeping sand out of water pump

SAND ENTERED our centrifugal pump when connected direct to the water-well pipe. Then sand was delivered to engine cylinder's water jackets. I installed a sand separator on suction side of pump to avoid damage to the pump, sketch. It also prevents sand settling in water jackets of engine.

A CAMACHO *Cebu, P. I.*

BILGEWATER on Marmaduke's barefoot technique for locating underground steam leaks, POWER, June, p 154. It worked for him because his steam line was buried directly in the ground and he had a complete break. I'd like him to pinpoint a small leak in a tile job.

We have a private-street steam system. Steam at 125 psi runs through 6-in. and 8-in. underground mains to distant reducing stations, then is reduced to 10 psi for domestic use. Pipe is all-welded-steel, mounted on rollers on a concrete pad. It's insulated with 1-in. magnesia, tar-paper-wrapped and sealed inside a vitrified tile duct. A 4-in. copper condensate-return line is also in same duct. They are buried 6 feet below grade.

We first discovered steam leaking into our plant around the outside of a 6-in. main where it passes through the wall. Steam was coming out in volume but with no apparent pressure. I reasoned leak was some distance from plant. First manhole, which contains two corrugated expansion joints, was 500 ft away. Check of this pit revealed no evidence of vapor or excess heat. Thus, leak was closer to plant than the pit.

Remembering Marmy's success in walking barefoot on ground until he found the hot spot, I sacrificed my dignity on the altar of science, removed my shoes and stockings and started pacing the length of the conduit in a zigzag pattern to cover the entire area. It was a blazing hot July day and all I learned for my trouble was that dirt becomes very hot in summer.

Early next morning before the sun became too strong and while a trace of dew was on the ground, I tried it again. This time there was a definite difference in temperature along the first 60 feet from the plant wall. Our plant crew entered into the spirit of the thing and took off their shoes, too. We looked pretty silly to passersby, but agreed that the soil was warmed the first 60 feet. But it was impossible to pinpoint the leak. One man suggested we drive pipes into ground and take temperature readings, but I reasoned (correctly I learned later) that steam was spreading through tile duct and heating ground uniformly.

Our best guess was that leak should be about in center and steam was spreading equally in both directions. We measured exactly 30 feet from plant wall and started digging. After digging two days we uncovered duct and removed one section of tile. Removing it was tough as it is brittle, breaks easily.

Upon removing the tile a great deal of steam escaped from the duct—we heard a strong hissing. Sound was transmitting through duct so it was impossible to judge distance. We knew the leak was farther downstream.

Here we called for help and brought in a mechanical digger to uncover remainder of 60 feet. We uncovered a section another 20 feet downstream, found we had gone too far and eventually located leak only five feet from our starting point.

A 2-in. section of weld was full of pinholes. Entire bottom half of weld was defective. Location was so cramped we couldn't weld underneath pipe so had to cut window in top, weld from inside.

As an anticlimax, digger chewed up a tile storm sewer, giving us another repair job. Moral: Don't trust your memory, check the plans before digging. We had marked location of other lines but had forgotten this one.

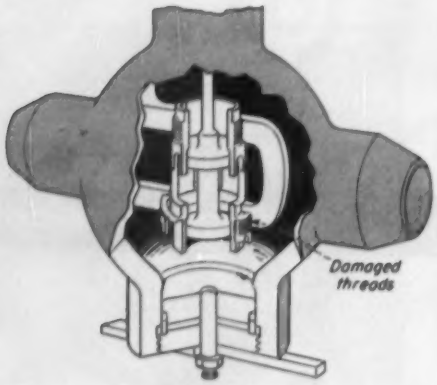
Thanks to Marmy we only messed up 30 feet of our prized lawns. Perhaps there is a still better way. What would *you* have done?

W J STEINERT *Flushing, N. Y.*

(*Continued on page* 128)

# More PRACTICAL IDEAS

Begins on page 126



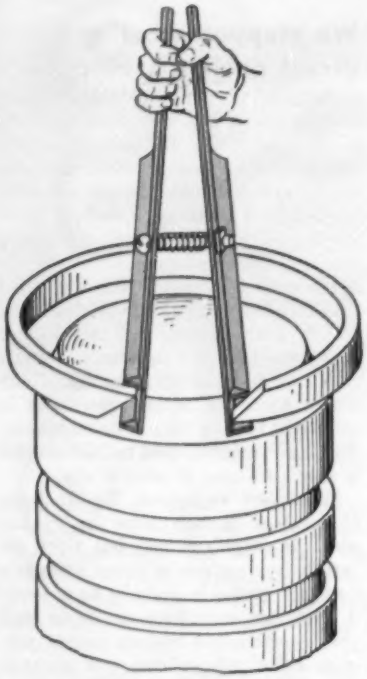

## Here's your 'trick' of the month

When mechanics removed locking ring from our automatic feedwater-regulating valve, they damaged the threads in valve body. While damage wasn't serious, it was bad enough so new locking ring would not enter.

If valve had been flanged and the bolt a type that could be removed from line, we could have moved it to machine shop and repaired the threads. But cutting the welding joints wasn't practical. Foreman suggested either getting a special 6⅜-in. tap or grinding threads out and welding in new ring. Superintendent didn't like either idea.

I suggested trimming threads on the old ring that came out of valve, then cutting flutes around the outside to make ring into a tap. We did this and used it as a tap to clean up the body threads. All this took only two hours and the new locking ring was screwed into place without any trouble.

C H Shen *Formosa*



## Now, homemade tool removes piston rings

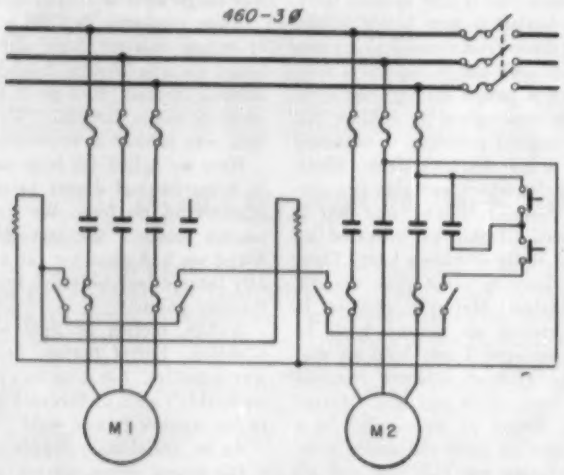
Sketch shows tool that I made for removing and replacing piston rings on our diesel engines. It is 16-gage sheet metal, bent to form an angle. Angle ends are closed by brazing or soldering triangular sheet-metal pieces to form a pocket to place piston-ring ends in.

Two angles are held together loosely with a ¼-in. stove bolt and a spring placed over bolt between two pieces.

To remove or replace piston ring, insert its ends into small pockets as shown. Press handles of tool together to expand ring. It is then raised or removed from piston. Side of angle acts as a guide to prevent end of ring falling into piston-ring grooves as it's being raised.

M L Monson *Fosston, Minn.*

(*Continued on page* 130)




## Why not use fuses before motor starters?

Ziemke solved the problem "Synchronized starting and stopping of identical motors," in Nov Power, p 134. I made similar installation, also in cocoa industry. However, I have one comment to make regarding his wiring.

His diagram shows two motors protected by an overload device in each starter and one set of fuses in line. These fuses must be of ample capacity to take starting load of two 20-hp motors, at same time. That's much higher than normal full load of each motor. Right-size fuses, installed before each starter, add inexpensive protection.

A C Veen *New York, N. Y.*

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**To learn how you can win recognition for your accomplishments, see pp 80-81.**

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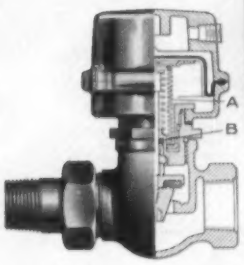


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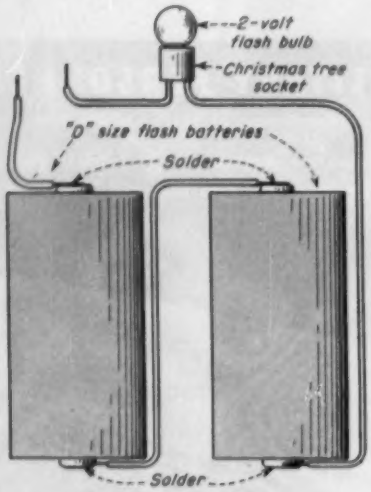
# More PRACTICAL IDEAS

Begins on page 126

## Handy drill stop

INSTRUMENT PANELS and similar fittings required clean and unmarred appearance. You can prevent chucks of portable electric drills from touching metal surface and scoring with unsightly marks. Just run the drill through a piece of wood as in photo.

C T BOWER *London, England*




## Continuity tester

SKETCH NEEDS no explanation. When the tester has been constructed, thoroughly insulate the batteries with tape so that it won't short out when it is stored away.

Be sure to keep the two leads separated when not in use.

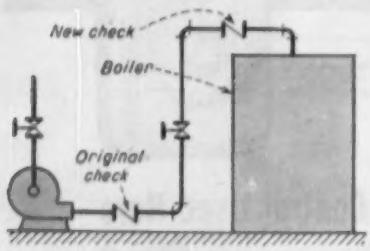
B A CROSSON *Graston, R. I.*

duty Edison sockets, mounted along top of panel. Lamp was wired as shunt around breaker gap so leakage current flowed through lamp as breaker opened. Even though we had 50-watt mill-type inside-coated red lamps, they often failed to attract attendant when he was not in front of board.

We needed an audible warning device. With this in mind, salvage room produced six relays with double contacts wound for dc operation. Normally, closed contacts were wired into a series of green 5-watt lamps, mounted on a neat panel on operator's desk. Intermittently closed contacts were wired to red lamps and a buzzer. Current was 12-volt ac supplied from an instrument transformer.

New system is neat, compact and troublefree. Six green lamps behind their jeweled bezels glow prettily with all breakers set. When outage occurs, red lamp's gleaming among its fellow green members makes an outstanding contrast that's very noticeable. For those rare occasions when neither hoisting engineer nor operator is in the line of sight, buzzer attracts your attention and identifies open circuit.

P C ZIEMKE *Oak Ridge, Tenn.*




## Two check valves stop water hammer

WE WERE ALWAYS CHANGING check valves in our boiler feed-line until we found this solution. Feed pump is a motor-driven turbine-type job that starts and stops at frequent intervals. This caused considerable slamming of check disk. Then disk would start leaking, which caused the pump to steam-bind. We tried various makes of check valves, but all started leaking after a short time.

As an experiment, we installed a second check valve on top of boiler to absorb the shock, and left original check nearer the pump to act as sealer. This completely eliminated our trouble. It also stopped the severe water hammer in feed line.

R J ANDERSON *St. Paul, Minn.*

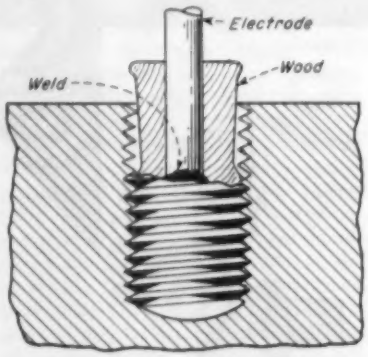
## This alarm device works

NOISE LEVEL is sometimes high in a power plant, especially noises that match those peculiar to snap of rapidly opened circuit breakers. We had this nuisance in a large engine room that housed compressors, operational relays, motor-generator sets and two large mine hoists. These hoists operated on 2300 volts through primary, and seven steps of secondary contactors, a total of 16 clattering noisily all day long.

So the switchboard attendant couldn't be blamed when some one had to walk a half mile underground to complain of an open traction circuit. Conflicting noises would have had the poor man baffled unless he had kept checking on position of breakers at frequent intervals.

We tried making a warning device by drilling a hole through slate panel beneath breaker so reset handle would swing down, strike on push rod to close a spring-blade switch. Device failed often because under certain conditions the breaker fairly exploded to slam reset handle down with terrific force. So switch blades distorted inevitably.

Next, we placed a series of heavy-

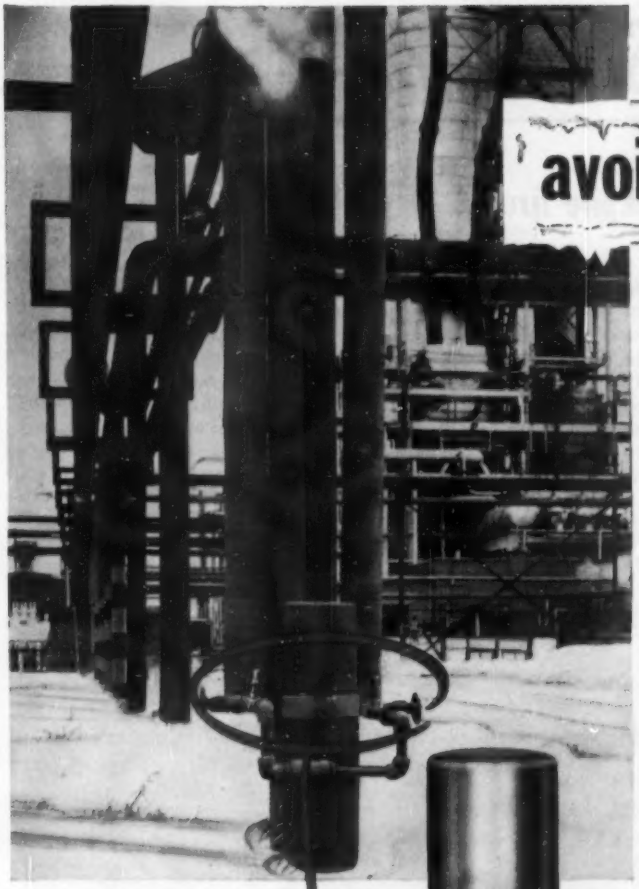



## Removing broken studs

WHEN SMALL TAPS, screws or studs are broken off below the surface of a casting, drive a tapered plug of soft wood into the tapped hole. Drill a small hole into wood, sketch. Drive plug down onto the tap hard. Hole in plug is for inserting an electric welding electrode.

Run weld metal on top of tap. While it's still molten, stick in a copper rod. It can be welded to tap so it can be screwed out. If wood is well hammered down, it will keep the molten weld metal away from the edges of the hole.

W E WARNER
*Woodford Green, Eng.*



# avoid freeze-ups

## . . . use Yarway impulse steam traps

Don't take chances with equipment freeze-ups and costly production delays. Put Yarway Impulse Steam Traps on all lines subject to freezing temperatures.

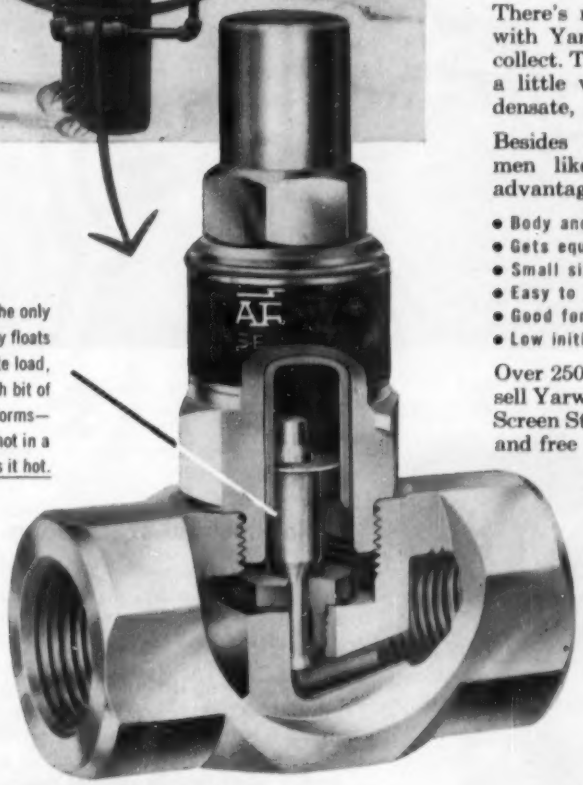
There's no danger of your lines freezing with Yarway traps. Condensate does not collect. The only moving part of the trap—a little valve—continually tests for condensate, discharges each bit as it forms.

Besides this non-freezing feature, plant men like these other Yarway Impulse advantages:

- Body and all working parts are stainless steel
- Gets equipment hot in a hurry and keeps it hot
- Small size . . . light weight
- Easy to install . . . easy to service
- Good for all pressures
- Low initial cost

Over 250 Industrial Distributors stock and sell Yarway Impulse Steam Traps and Fine Screen Strainers. For name of one near you and free trap booklet, write . . .

**YARNALL-WARING COMPANY**
100 Mermaid Ave.
Philadelphia 18, Pa.



This little valve, the only moving part, actually floats on the condensate load, discharges each bit of condensate as it forms—gets equipment hot in a hurry and keeps it hot.

**YARWAY® impulse® steam traps**

# PLANT PROBLEMS . . . *helpful info from readers*

## How can we find, put out stockpile fire?

**HERE ARE THE FACTS: We store between 50,000 and 100,000 tons of coal in an outdoor stockpile served by a radial-type drag scraper having its back post on a semicircular track.**

**Ever since we started this stockpile two years ago we've been plagued with hot spots and fires. Nothing tried to date has been successful in eliminating the trouble. Though coal losses are not high, it is still a waste to burn it outdoors instead of under our plant boilers.**

**What are good ways of finding hot spots and fires? How are fires best put out once they are discovered? Will a change in stockpiling methods help?—*NB, October Power***

## Here are the answers

**CRAWLER TRACTORS** give us excellent results when packing a pile. Proper packing, with emphasis on cross- and edge-rolling for good sealing, has proved most successful for preventing fires in our plant.

We use a temperature probe made of ½-in. pipe fitted with a thermocouple to find pile temperature. Periodic exploration of the pile at various depths allows us to find hot spots before they become serious.

Flooding fires with water has not been of much use. As soon as we discover a hot spot in the pile we dig it out and fill it with new tightly packed coal, or pack the edges of the hole, being sure the sides taper to the center.

B M KECK *Austin, Minn.*

### Mobile coal-stockpiling equipment

Tractor, *above*, compacts the slope of a big coal stockpile. Compaction by this type of rig helps prevent spontaneous combustion, while the proper sloping gives good drainage. This plant stockpiles some 600,000 tons of coal and burns 5000 tons per day.

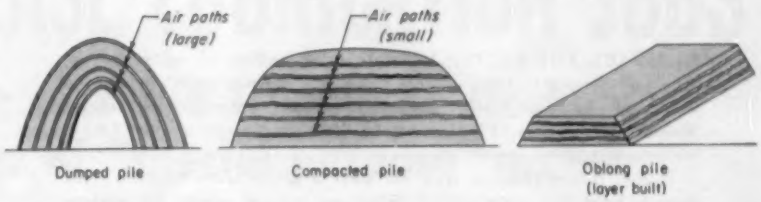
End of the up-slope haul is the top of a large stockpile, *above left*, where the tractor-bulldozers spread their loads into well-compacted layers. Scraper, *lower left*, spreads a thin layer of coal on a utility stockpile. At this plant, mobile rigs for compaction provide the most economical method for moving coal in and out of storage. It also provides better fire protection.

DON KELLAND *New York, N. Y.*

# on stockpile fires and ash fusion

TYLER HICKS, *Associate Editor*

**SEGREGATION** occurs when fines and coarse lumps are stored in a pile together. When dumped on the pile, the fines stay at the center but the coarse lumps roll to the outside of the pile. The resulting passages which are produced allow excess air to flow in some locations while insufficient air is obtained by others. Spontaneous combustion usually results.




The sketches show three types of piles. All have been successful and are easily made with equipment like drag scrapers, bulldozers, rubber-tired scrapers and even trucks.

Temperature probes employing portable thermocouples can be used to find if pile temperature is critical—160 F or higher. Give particular attention to the temperature of pile edges and slopes. If it is too high, more compacting often reduces air flow enough to retard combustion. If necessary, heated coal must be removed from the pile and spread on the ground where the fire is easily extinguished. It is usually better to use the salvaged coal immediately than to try to repile it.

Carbon dioxide, fed through a pipe fitted with drill points, is often effective in extinguishing coal-pile fires. Avoid using water because it sets up conditions favorable for more fires.

Don't pile coal around posts, crane supports, fences and other structures because pile density is less at these points, allowing vents for air and gas movement. Never use pipes or ducts in an attempt to ventilate a coal pile.

H B WAYNE *Brooklyn, N. Y.*

---

**DIAL THERMOMETER** with a tube long enough to reach point to be measured is effective in finding hot spots. Of course, the tube must be inserted in a pipe previously driven into the coal pile.

E W MCKNIGHT
*Chapel Hill, N. C.*

**SPONTANEOUS COMBUSTION** in a 25,000-ton stockpile plagued us at a time when it was impossible to move the pile because coal being delivered was in the way. We located each hot spot and successfully extinguished the fires with dry ice inserted in the pile.

After finding a spot we drove a pointed 2-in. pipe into it. The pipe had a series of ⅜-in. holes near the point. After filling the pipe with dry ice it was capped and left in place. The $CO_2$ gas and cooling effect of the dry ice soon eliminated each hot spot. Each pipe had to be refilled several times with dry ice at about 2-hr intervals before the spot was eliminated.

Hot spots along the pile edges were extinguished by burying 50-lb blocks of dry ice directly above them. We used half a ton of dry ice costing 4.75c per lb to extinguish all the hot spots in this 25,000-ton pile.

A R EASTCOTT *Princeton, Can.*

**INVERTING PILES** of run-of-mine coal reduced the number of fires in our plant. While fires were not entirely eliminated, inverting saved us some coal. Of course, you must set up an economic balance because coal-pile inversion increases handling costs. These may wipe out any fuel savings that are obtained by this method of handling.

M G BITTEL *Glenside, Pa.*

**SEAL PILE EDGES** with a coating of asphalt and ground limestone to reduce air circulation. Hot spots will then seldom recur.

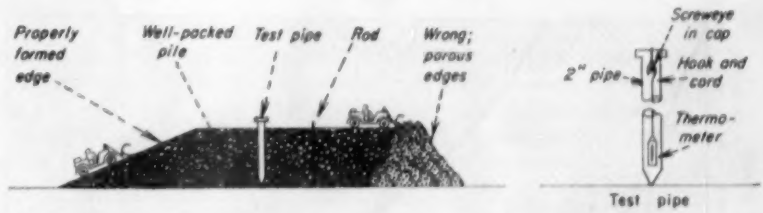
E Y KIMMERLY *Oak Ridge, Tenn.*

---

**STOCKPILE FIRES** usually start from spontaneous combustion. Storing coal under water is one way of avoiding this loss, but the expense of a large storage bin is usually too great.

Two basic rules of successful storage are: (1) Keep different sizes separate. (2) If sizes cannot be separated, pack the fines into the coarse so there are no air pockets in the pile.

Wet coal gives off vapor readily visible on cold days when there is a fire under the pile surface. Drive a rod into the pile at the hot spot. Remove after an hour and feel the end. If it is hot there is a fire or the coal is near its ignition temperature. Repeat at intervals over the entire pile.




Pipes with one end closed and the other capped may also be used. Drive the closed end into the coal when a fire is suspected. Remove cap from the end and lower a thermometer to the bottom. Allow enough time to obtain a true temperature reading before removing the thermometer from the pipe. By this means the temperature at the pile bottom is easily obtained. Sketch shows a typical arrangement for the thermometer and test pipe. Of course, this can be changed to suit storage conditions met in the plant where it will be used.

ALBERT H MOULTON
*Pittsfield, Mass.*

(*Continued on page 204*)

More answers to plant problems on page 134

# More PLANT PROBLEMS

Begins on page 132

## Is sulfur related to ash-fusion temperature?

**HERE ARE THE FACTS: In studying the effect of sulfur on the ash-fusion characteristics of coal I found a definite relation between percentage of total sulfur and ash-fusion temperature in several West Virginia coals. Plotting total sulfur percentage against fusion temperature gives nearly a straight line.**

**Is this linear relation true for only a given seam or area? Or does it hold for other coals? What are typical curves for various coals?—*FR, October Power***

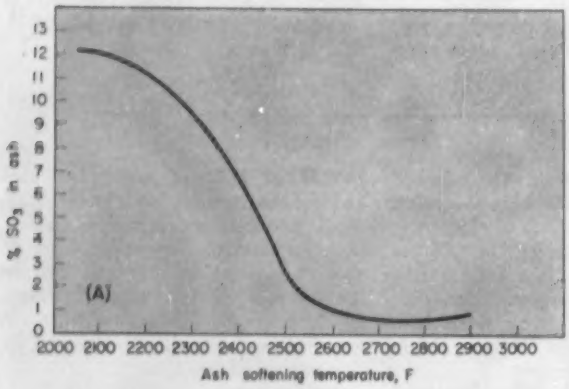
## Here are the answers

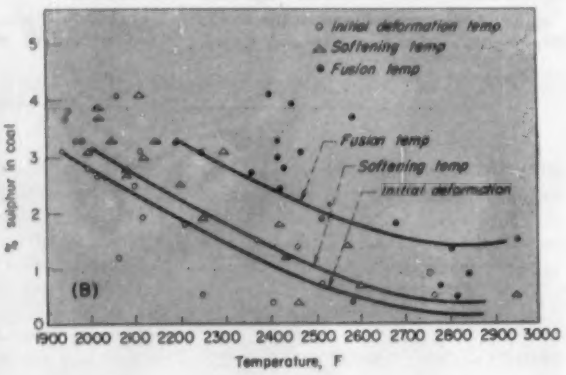
**SULFUR IN COAL** occurs mainly as iron sulfide, commonly called pyrites, organic sulfur, and as sodium sulfate. These constituents, as well as alkalies, alkaline earths and iron oxide all seem to vary inversely as the ash softening temperature.

VICTOR J COTZ *Allendale, N. J.*

**GENERALLY** there is no relation between sulfur content and ash-fusion temperature. Sulfur in the form of pyrites in certain coals may have some relation to the ash-fusion temperature because of its conversion to iron oxide. But other variables present may influence this relation.

O W PALMENBERG *Tenafly, N. J.*

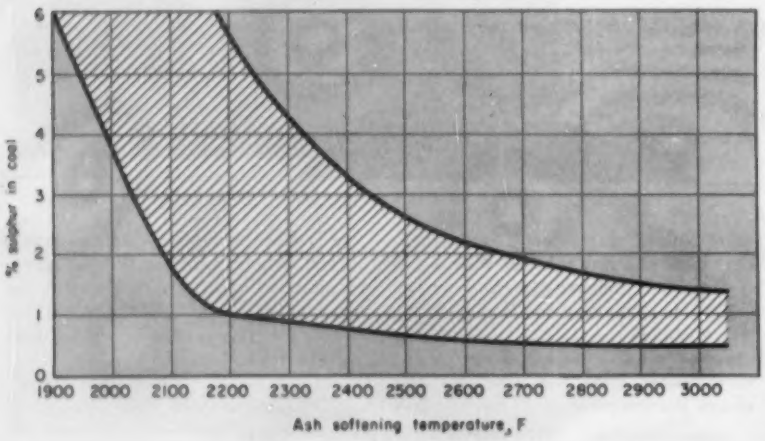



**FIVE STATES** are represented in curve *A*: Montana, Illinois, Pennsylvania, Kentucky and West Virginia. Data used in plotting the curve were obtained from tests on sub-bituminous and bituminous coals mined in these states. Fusion temperature rises as sulfur decreases.

Curve *B* is a plot of three characteristics of coal from 21 different seams in various states throughout the U.S. This curve confirms the theory that for most coals ash-fusion temperature increases with decreasing sulfur content regardless of coal source.

H B WAYNE *Brooklyn, N. Y.*




**ASH FUSION** is not the correct nomenclature. Softening temperature is more suitable and is the temperature at which the molten mass of the cone of ash becomes a spherical lump. This is the most important of the three critical temperatures of ash—initial deformation, softening and fluid.

Sulfur in coal is a contributing factor in clinkering and slagging. The compounds consisting of sulfur and iron in the coal lower the ash softening temperature. The accompanying curves show the relation between ash softening temperature and sulfur content for several Pennsylvania coals.

Coals having a high ash-softening

(*Continued on page* 136)

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Has exceptional oxidation stability under high temperature conditions. Recommended for all antifriction bearings. A general-purpose, high melting point lubricant for pressure gun and grease cup application.

### BUTTERY • Sun Grease 300A

Especially designed for pressure lubrication of bearings operated at normal speeds and temperatures. Can be used in pressure guns, compression grease cups, or pressure lubrication systems. Has high water resistance and excellent pumpability at low temperatures.

### TACKY • Sun Grease 897

For open gears, chains, slides, cams, linkages and bearings. Used whenever "throw-off" must be avoided. High adhesive and cohesive characteristics. An excellent lubricant that is water resistant and does not need frequent application.

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# More PLANT PROBLEMS

Begins on page 132

Donald Cochrane

## Who answers Plant Problems?

**DON COCHRANE, superintendent of the Cambridge, Minn. diesel plant, started his diesel training in the Navy. Coming ashore, he put his know-how to work in the Rural Cooperative Power Association, gaining wide experience in operating and maintaining a large number of diesels.**

**To keep himself well informed, Don takes correspondence courses. The suggester of short biographies on regular contributors to Plant Problems, Don says:**

**"Many times the answers bring out points I had not thought of in my own plant or give me a new angle for approaching my problems. I believe this to be of more value than the direct solution of one problem. Also, it constantly reminds me that two heads are better than one, no matter what the problem."**

## YOUR TWO JANUARY PROBLEMS

### 1 What's best way to measure tube temp?

**We have a 400,000 lb-per-hr boiler whose tube temperatures we'd like to measure during operation. We feel that these readings are excellent guides to safe operation.**

**How can thermocouples be installed in this boiler? What methods are used for attaching the thermocouples to tubes? Are spot-temperature measurements better than average measurements? How do you protect thermocouples, attached to superheater tubes? What are good materials for the thermocouple and its connected wiring?—*LO***

### 2 Does higher cost insulation pay?

**For rewinding motors in our plant, class H insulation has been recommended instead of class A or B. Advantages cited include longer life, greater load-carrying ability, better performance in hot ambients. But quotes on rewinding costs using this material run up to 60% higher than for class A or B.**

**What will class H give us that A and B won't? If motors can carry greater overloads with it, what will happen to their bearings? Will they burn out? Will using more than one class of insulation lead to trouble?—*JS***

*Will you help readers who sent problems? Extra pay for photos, sketches.*

temperature customarily have a small quantity of sulfur. But, as the curves show, not all coals with low sulfur have an ash with a high fusion temperature. With all the theories developed on this subject, there is still no specific relation between sulfur content and ash temperatures of available coals.

A J Breugelmans *New York, N.Y.*

**COALS FROM SAME BED** may show a relation, but checking Bureau of Mines reports does not confirm this on a national basis. Ash-softening temperature ranges from 1900 to 3100 F. This is an important yardstick because it is easily tested in a laboratory and is readily compared with the actual conditions in a furnace fuel bed.

Contrary to general opinion, ash content should play a minor role in coal evaluation. Since ash can be removed regularly to maintain necessary burning rates, high ash only adds labor costs. The cost per million Btu and per 1000 lb of steam are the figures that count.

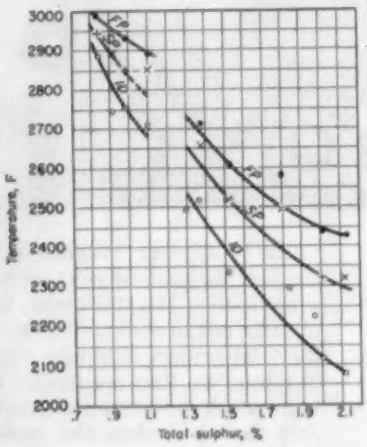
Coal with more than 20% ash is considered low-grade fuel today. Ash composition determines fusion characteristics. Silica, alumina, iron, lime and magnesia have a definite effect on temperature where clinkering, slagging and other changes occur in the physical structure of ash.

Ash softening at low temperature restricts some coals when burned in fuel beds or in dry-bottom pulverized-fuel furnaces. A high softening temperature is undesirable for slag-tap furnaces.

L W Fitzpatrick *Jefferson City, Mo.*

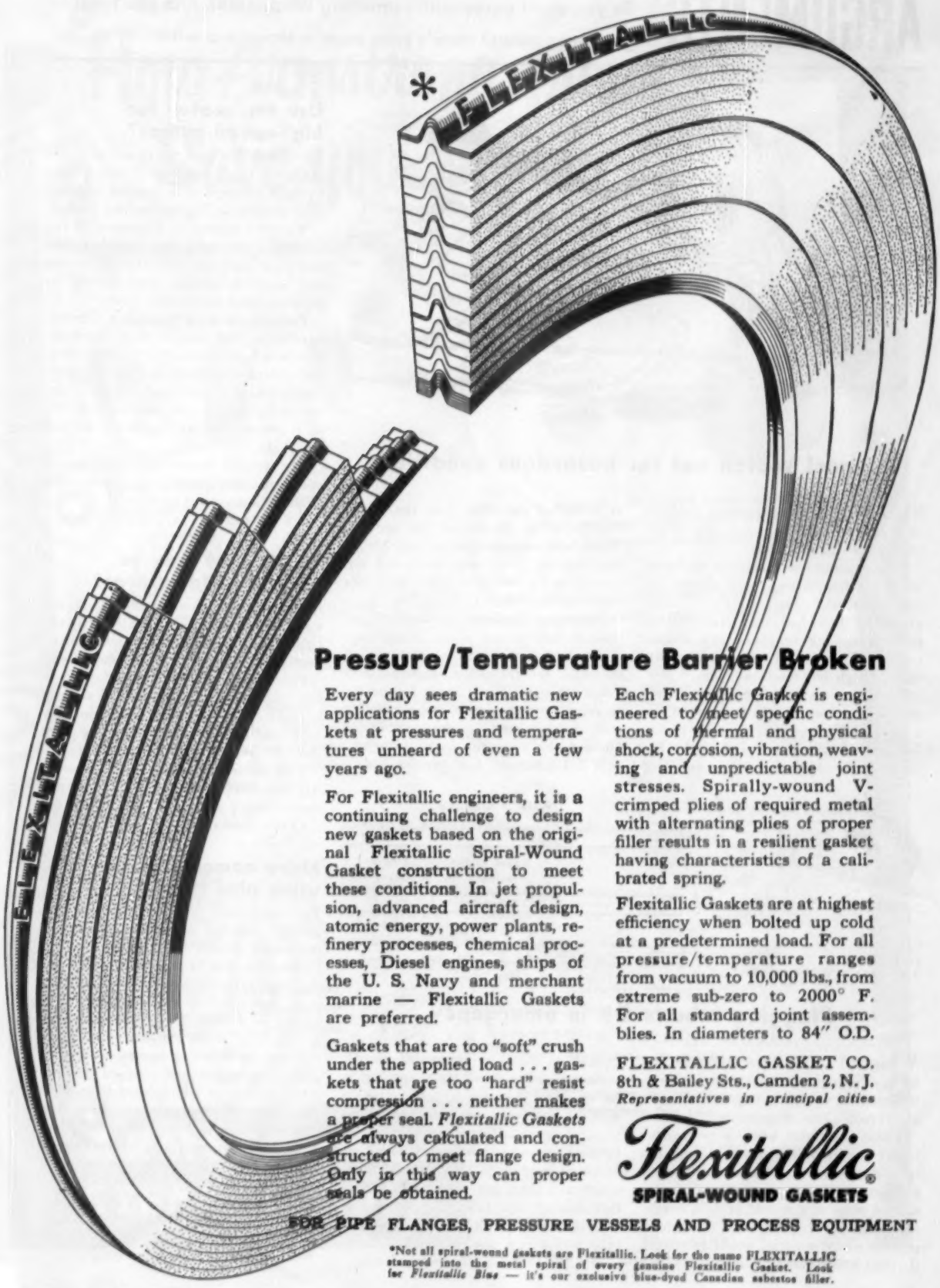
**WEST VIRGINIA** coals are plotted in the accompanying curve. They show a definite relationship exists between the percentage of total sulfur and the ash-fusion temperature.

Fred M Reiter *Dayton, Ohio*




**STUDIES** in Power as far back as 1924 indicate a statistical correlation between sulfur and ash fusion temperature—the greater the sulfur content, the lower the fusion temperature. But most au-

(*Continued on page* 208)




## Pressure/Temperature Barrier Broken

Every day sees dramatic new applications for Flexitallic Gaskets at pressures and temperatures unheard of even a few years ago.

For Flexitallic engineers, it is a continuing challenge to design new gaskets based on the original Flexitallic Spiral-Wound Gasket construction to meet these conditions. In jet propulsion, advanced aircraft design, atomic energy, power plants, refinery processes, chemical processes, Diesel engines, ships of the U. S. Navy and merchant marine — Flexitallic Gaskets are preferred.

Gaskets that are too "soft" crush under the applied load . . . gaskets that are too "hard" resist compression . . . neither makes a proper seal. *Flexitallic Gaskets* are always calculated and constructed to meet flange design. Only in this way can proper seals be obtained.

Each Flexitallic Gasket is engineered to meet specific conditions of thermal and physical shock, corrosion, vibration, weaving and unpredictable joint stresses. Spirally-wound V-crimped plies of required metal with alternating plies of proper filler results in a resilient gasket having characteristics of a calibrated spring.

Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000° F. For all standard joint assemblies. In diameters to 84" O.D.

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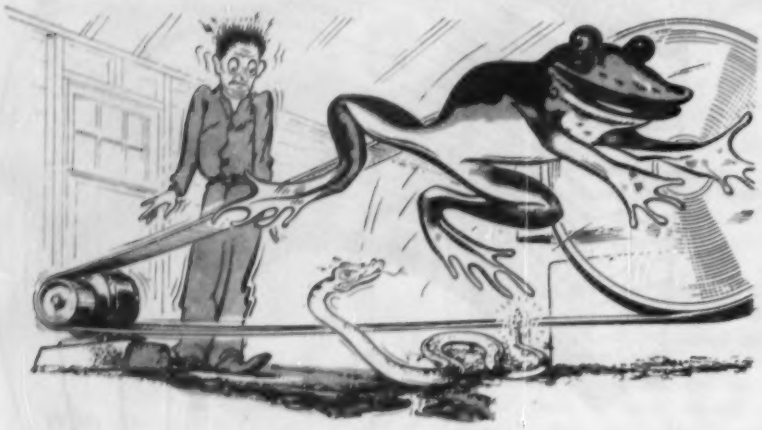
# ARGUMENTS

***So you don't agree with something we printed? And you want to give your views? Here's your page — shoot in a letter***



## Danger! Watch out for hazardous conditions

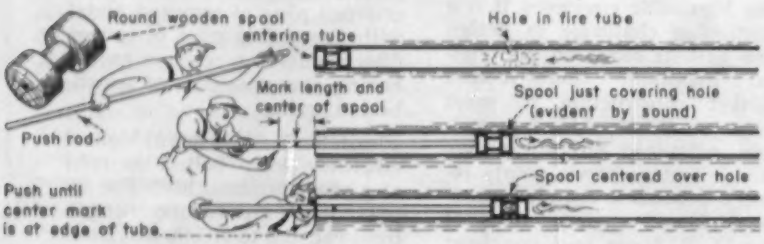
REGARDING the ever-recurrent problem of belt static, let me relate two of my experiences in the field.

In one compressor plant the machines were on foundations well above the ground level. The motors were grounded. Belts had considerable static, but not enough to cause any *serious* trouble. The ground was a rocky outcrop—rough but level—and dry.

In another plant, the compressors and motor were housed in a large shed, on a hillside. This ground was also rocky, but covered with gravel and earth. Because of the slope, one compressor was at a higher elevation than the other. Flywheels barely cleared the ground. There was a small natural trench running between the compressors and the motors, and a trickle of water kept this continually saturated.

There was absolutely no static at any time in this second plant. I attribute this to the nearness of the wet gravel to the belts. We did have a hazardous condition, though. Small frogs frequently traveled the watercourse, and sometimes rattlesnakes came in the compressor house looking for the frogs.

H T LIVINGSTON *Los Angeles, Cal.*


Round wooden spool entering tube
Hole in fire tube
Mark length and center of spool
Spool just covering hole (evident by sound)
Push rod
Spool centered over hole
Push until center mark is at edge of tube

## Plugging tube is OK in emergency

AS FAR AS I KNOW, there is no rule prohibiting plugging a leaky tube in a fire-tube boiler, for an emergency temporary repair (July *Arguments*).

There are times when a permanent repair is out of the question, particularly if a temporary repair can be made without sacrificing safety. For instance, aboard ship in a storm, or in a manufacturing plant part way through a process where material would be ruined if the boiler were shut down long enough to make a permanent repair.

Sketch above shows the pine plug to be used and the steps to insert plug in tube so hole will be centered in the annular space. Plug cannot blow out because pressure is balanced within it. Moisture from steam soon seals the plug, which will swell, but not enough to further damage the tube. At the opportune time, shut down boiler and replace tube with a new one.

M I SLOANE *S. Hingham, Mass.*

## Use this motor for high-speed pumps?

ALTHOUGH WE MAY NEVER GET into the realms of high pressure boiler plants, we have followed with interest your recent articles on big boiler-feed pumps.

We were especially interested in the methods proposed for running the pumps at high rpm with electric motors and speed-increasing gear boxes, to keep impeller dimensions down.

Recently, looking through a German handbook, we noted that Siemens-Schukert have built electric motors that are motors within motors for high-speed wookworking machinery. They get speeds up to 6000 rpm with 50-cycle ac; so it seems that with 60-cycle ac one could get 7200 rpm.

Can anyone in the field give us an opinion on this possible solution to some of their pump drive problems?

J S MILLER *Seattle, Wash.*

## Is this best way to control welding fires?

IN REFERENCE to your article "28 tested ways to prevent fires," October POWER, I think you should make an addition to item 28, welding and cutting operations.

Every welding booth should have a fire extinguisher, preferably of carbon tetrachloride or another nonconducting medium. Every portable welding unit should have two small extinguishers.

Fast action will put out a fire at once. All fires start small; even an explosion starts from a spark.

CLYDE HOWARTER *Canton, Ill.*

## More comments on using pine plug

THE DISCUSSION of the virtue, if any, and propriety of using pine plugs as a temporary repair for seriously leaking boiler tubes has been interesting to say the least. Marmaduke Surfaceblow, Esquire, has come up with an answer that cannot be disregarded—"You can't run for the book while the ship sinks."

Many times boiler owners, whose ingenious operators had plugged leaking tubes, have been admonished to replace the tubes. Inspectors have been instructed frequently and in detail that plugging tubes, particularly with metal caps held by a threaded through rod, is very bad indeed.

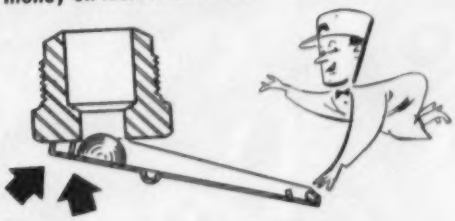
End of the rod exposed to the furnace invariably disintegrates with highly undesirable results, particularly if you are

*(Continued on page 196)*

# How Armstrong Traps Save you Money

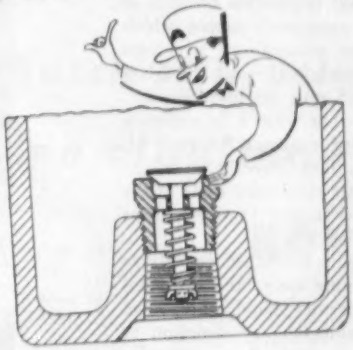
Choice of body styles saves money on installation costs.

Hardened, ground and lapped valve and seat; stainless steel mechanism resists wear and corrosion—saves money on maintenance.



Two phase leverage means higher capacity in a smaller trap. Armstrong traps have optimum relation between leverage, valve travel, bucket weight, capacity and overall size.

This internal check valve saves labor and fittings required to install regular check valve.



This trap with built-in strainer costs less than separate trap and strainer—requires less labor and fittings to install.

Get the full facts on money-saving Armstrong traps. Send for free Catalog J. Clip and mail coupon today.

**ARMSTRONG MACHINE WORKS**
812 Maple Street, Three Rivers, Michigan

Gentlemen: Please send me a free copy of Catalog J, The Armstrong Steam Trap Book.

Name _____

Position _____

Co. Name _____

Address _____

Please Print

**ARMSTRONG STEAM TRAPS**

# HOW TO

## cover your roof in one operation

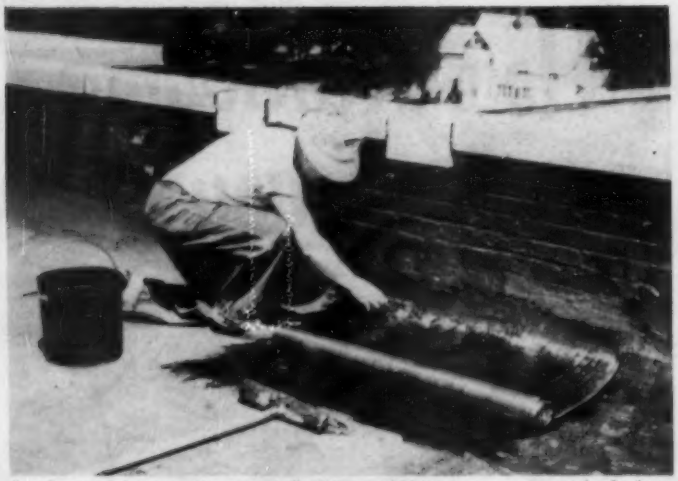
INORGANIC fabric woven-roofing shown is made entirely of glass fibers. It does not char, burn, rot or become brittle, wear or tear, according to the maker. Reroofing and repairing with this material is a one-step job of applying the coating to the reinforcing glass-fiber membrane. This is possible because of glass fabric's open-mesh weave, which allows bitumen coatings to penetrate *through* the mesh, surround the glass fibers and bond with the undersurface.

There's no labor wasted in applying base and finish coatings because all coating is applied directly *over* the membrane. This eliminates some of the old reroofing techniques that took three steps.

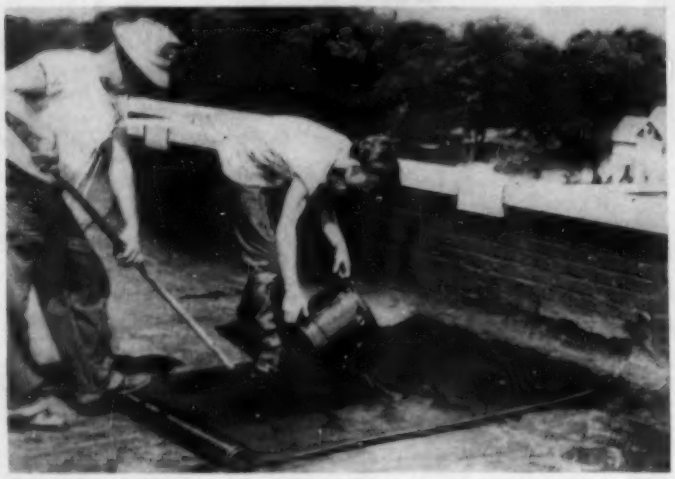
Since inorganic fabric shown acts as a true reinforcing mesh and does not depend on adhesive bond, there's no chance for "sandwich" construction or delamination. Such faults are usually caused by air or water trapped between layers of common roofing materials, which then cause leaks.

One-ply application with this roof coating is water-tight protection for at least 10 years without recoating, say the makers. This material takes place of the old-style 3-ply application asphalt-saturated felt and bitumen.

*Courtesy, Twinsburg-Miller Corporation, Twinsburg, Ohio.*



1 Coat roof in small area at flashing with bitumen so one end of glass-fiber roll anchors firmly. This is only place you need bitumen under glass fiber: it imparts enough strength to bitumen surface for roof traffic



2 No base coating is needed with this one-step technique as all bitumen goes on membrane top. Open-mesh weave allows coating to penetrate mesh, surround glass fibers and key to roof. One roll covers 1100 sq feet

3 Complete by squeegeeing and brushing out, all at one time. One roll of this material weighs 17 pounds, while felt weighs about 60 pounds and covers only 400 sq ft. Less weight and one-ply application saves on cost

E. A. Hamann (left), Power Generation Engineer and Robert Best (right), Superintendent of Utilities, go over lubrication records with Bill Schall, Standard Oil lubrication specialist. Bill Schall has been providing technical sales service to Standard Oil customers since 1943. Bill is an engineer with a B.S. in engineering from Georgia Tech., and a graduate of Standard's Sales Engineering School. Customers of Bill's find this experience and background pay off *for them.*

# *Anheuser-Busch still using same turbine oil after 24 years*

# ...NONPAREIL

For more than 24 years the Anheuser Busch Brewery, St. Louis, Mo., has been operating two 3,000 kw., turbines using NONPAREIL Turbine Oil. Three more turbines added to the system in 1940, '48 and '51 have also used NONPAREIL since beginning operations. The reason for choosing NONPAREIL is clear; it is guaranteed for the life of the turbine.

Since the initial installation, Anheuser Busch has not had to replace a NONPAREIL Turbine Oil fill. Neutralization number is always far below 0.15 mg. KOH/g., the degree of acidity Standard Oil guarantees NONPAREIL will not exceed. At nearly all times neutralization number is on the order of 0.03 mg. KOH/g. (See chart).

In all these years, oil systems have remained clean. There has been no problem of oil acidity in any of the five turbines. The delicate art of brewing world famous Budweiser goes on without concern over power failure due to lubrication failure.

Like to know more about NONPAREIL and its possible use in your turbines? In the midwest call your nearby Standard Oil lubrication specialist. Or, contact Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

**Anheuser-Busch Turbine Lubrication Record**

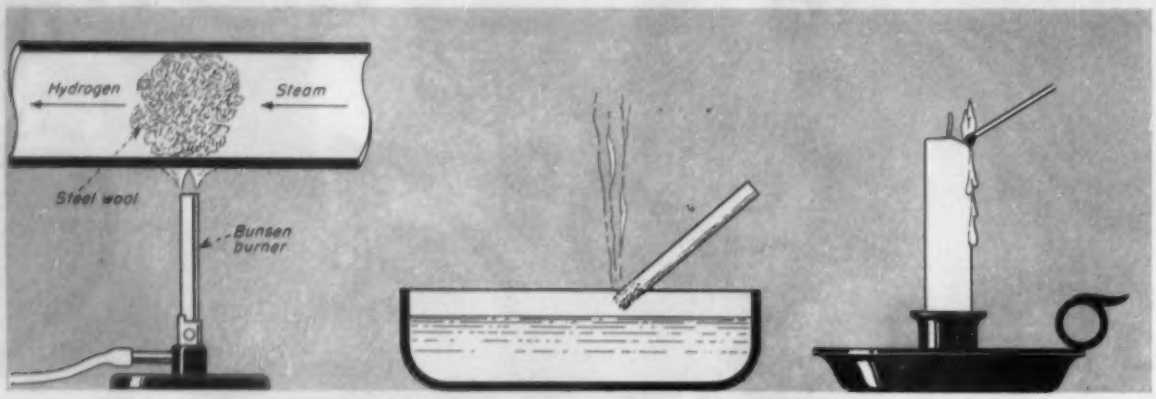
| Generator Capacity | Start up and NONPAREIL Installation Date | Date of Last Oil Analysis | Neutralization Number |
|---|---|---|---|
| 3,000 kw. | Oct. 2, 1930 | July 20, 1954 | 0.03 |
| 3,000 kw. | Oct. 2, 1930 | July 22, 1954 | 0.02 |
| 2,500 kw. | June 10, 1940 | July 20, 1954 | 0.03 |
| 7,500 kw. | Jan. 2, 1948 | July 22, 1954 | 0.03 |
| 7,500 kw. | July 26, 1951 | July 22, 1954 | 0.01 |

STANDARD

**STANDARD OIL COMPANY**
(Indiana)

# BASICS . . . *bringing engineering theory down to earth*

TOD WALDRON, *Assistant Editor*




**STEEL** oxidizes here to give hydrogen. Combustion is special form of oxidation

**CIGARETTE** won't light liquid gasoline or oil but spark will explode the vapor

**CANDLE** without wick won't light. Wick draws up the melted wax so it vaporizes

# How fuels burn - 1

► LAST MONTH Phil Swain wound up "Headwork Department" when he completed "Combustion Facts." This month we start a new series under a new department name. The theme is the same—engineering fundamentals made easy.

In his last ten "Headworks," Phil talked about the chemistry of combustion. This is an important phase of fuel burning, but not the entire story. The mere presence of fuel and oxygen together doesn't give good combustion. Proper mixing, right furnace temperatures, etc, make efficient burning possible. So, to give the practical side of the picture, our new series tells about actual fuel burning.

First, we will cover the mechanics of burning. Then we will follow this with practical hints to good combustion for the operator. Let's start by talking about oxidation, the basis of all combustion.

**Oxidation** takes place continually all around us. Iron combines with oxygen to form rust. Silver tarnishes, copper takes on a soft green oxide coat. Industry produces hydrogen by passing steam over hot iron (see illustration). Here oxygen in steam combines with iron to form rust, leaving hydrogen. Common useful oxidation takes a special form in burning or combustion. In it, oxygen combines rapidly with fuels and substantial amounts of heat are given off.

Sometimes combustion may be self-starting. For example, coal piled outdoors combines slowly with oxygen in the air, giving off heat. If the heat doesn't get away, temperature rises, the reaction speeds up and eventually becomes rapid enough to be called burning.

**How burning starts.** Such *spontaneous combustion* is not too common. We are more familiar with combustion that begins with heat applied from some external source. A fire laid in the grate will not light itself. Nor, for that matter, will a match. We start the burning process by striking it to generate friction heat enough to set it aflame, then use the flame's heat to light kindling, and the kindling's heat to start the logs. This process of using an easily ignited object to provide heat for ignition of another is common in engineering practice.

We are aware that some things burn more readily than others. In general, this depends on how easy it is to turn the particular substance into a gas, *because nothing truly burns unless or until it is a gas.* This, in turn, depends on the nature of the substance and on its amount as compared with the amount of heat available to start the process.

We can find any number of common examples to illustrate the point. The pool of gasoline in the illustration won't light when a cigarette is held to it. If you have ever tossed gasoline on a slow-burning brush fire to really get it started—not recommended incidentally—you probably put out the fire already going. But let it set for awhile and then toss a match in. Things get hot but fast.

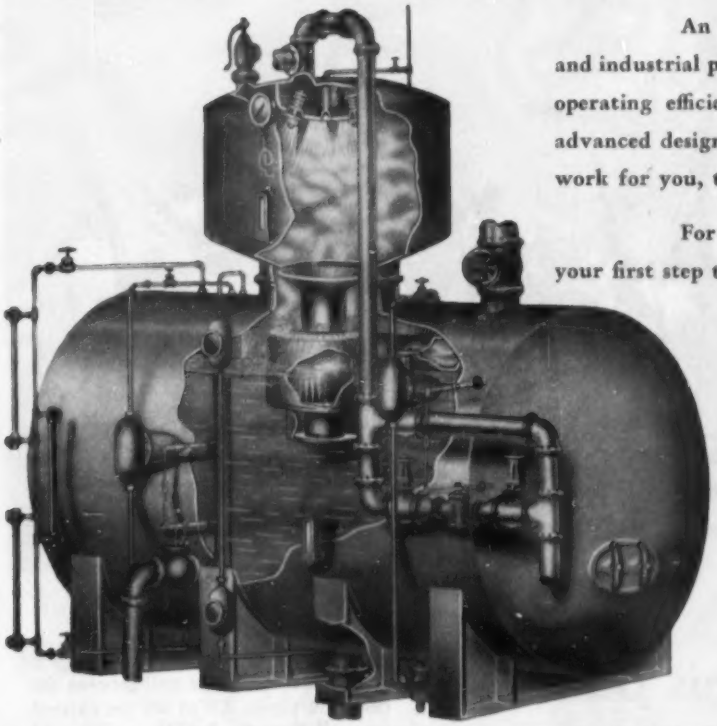
Wax in a candle won't burn until it is turned into a gas. But a match doesn't give enough heat to vaporize the wax. Its heat is much too small compared to the mass of wax. It will melt the wax some, though, enough to let the wick draw up the melted wax by capillary action.

Heat of the match flame is now enough to vaporize the very small amount of wax drawn up by the wick. Once the wax is vaporized, heat of the match lights it easily. And heat from the burning wax keeps the candle going.

Although the wick is eventually consumed, it contributes nothing to the burning. It is purely a mechanical device to create conditions needed to start and maintain combustion. It finds its counterpart in burners, stokers and furnaces, for while combustion is essentially a chemical reaction, most practical problems of fuel burning are mechanical.

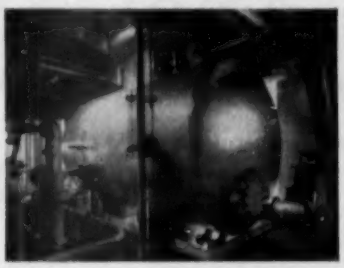
# *In Deaeration, too*

# BELCO Builds a Complete Line-



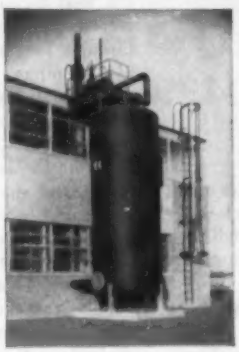
An increasing number of well known utility and industrial plants are using Belco equipment to increase operating efficiency and decrease operating costs. Belco advanced design and application experience can be put to work for you, too.

For technical assistance write or call Belco — your first step to lower costs.



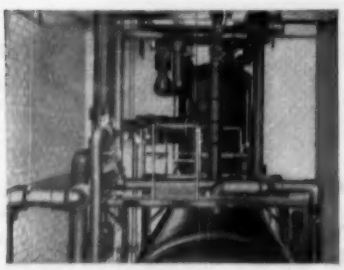
**SPRAY TYPE** — Belco Deaerator in large eastern oil refinery. Has a capacity of 300,000 lbs/hr.

**MARINE TYPE**—Typical Belco marine heater furnished to shipyards. (Approved by Lloyds of London)

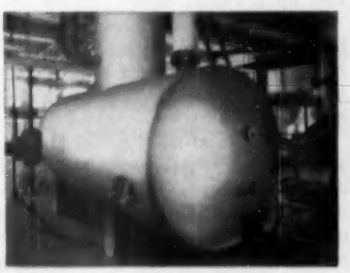


**OPEN TYPE**—Deaerator at large eastern pharmaceutical plant. Capacity of 80,000 lbs/hr.

**VACUUM TYPE** — Unit shipped set-up to midwestern utility. Has 150,000 lbs/hr capacity.



**SPRAY TRAY TYPE** — Belco Deaerator at New York State institution boiler house. Capacity 120,000 lbs/hr.



**TRAY TYPE** — Belco Deaerator at southern municipality. Has a capacity of 125,000 lbs/hr.

Belco

*Boiler Feedwater Heaters • Water Softeners • Filters • Clarators*
*Demineralizers • Automatic Process Control Panels*

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*Representatives in all principal cities of the United States and Canada*

**BELCO DESIGNS, ENGINEERS & FABRICATES WATER PROCESSING EQUIPMENT**

"Posy wired up a lot of fancy instruments to the hot line that impressed all the white-collar boys, but he wasn't fooling me."

# Marmy takes off his pants – for science

► "THEY SAY I tell many stories," said Abe Lincoln during those tragic Civil War years. "I reckon I do; but I have learned from long experience that plain people are more easily influenced through the medium of a broad and humorous illustration than in any other way; and what the hypercritical few may think I don't care."

After reading these lines, my thoughts naturally turned to Marmaduke Surfaceblow, consulting engineer extraordinary. For, after all, he always proves a point by telling a story.

"NOW HEAR THIS," I heard him roar as I climbed the rickety old stairs to his dingy office above O'Houlihan's Machine Shop & Engine Works. Stepping inside the smoke-filled office, I found the place packed with an assortment of waterfront characters. Marmy sat in his battered swivel chair, blowing his own cloud of cigar smoke and pouring himself a cup of java from the coffee pot on his pot-bellied stove. After a hearty swig, he boomed, "BILGEWATER on fast-talking salesmen. I'll tell you boys about the time I made one peddler back-water in a hurry." Marmy then leaned back in his swivel chair and roared away in his foghorn voice.

"Back in 1910 I was chief engineer on the coal-burning freighter SS *Sea Devil* of the Louisiana Sulfur Co. Those sulfur boats were messy because that dry yellow stuff got into everything. But I had a good crew and our machinery below was shipshape.

"Because our ship chalked up a good fuel record, the firm's general manager asked me to straighten out their power plant ashore. He wanted me to cut down fuel consumption. I took the job after he agreed to give me a free hand.

"Sulfur was brought out of the ground by the Frasch process from 900- to 1600-ft-deep wells. The sulfur-containing strata at bottom were reached after boring through the overlay of rock. Then three concentric pipes of 8, 4 and 1½ in. diameters were driven into the hole. Superheated water at 168 C was pumped down into the well between the two outer pipes. Air at 500 psi entered the well through the 1½ in. line and forced the melted liquid sulfur up through the space between the 4 and 1½ in. pipes. Sulfur was then carried through steam-heated insulated pipelines to large bins 1000 ft or so long, to solidify.

"From the large boiler room and air-compressor shack we had over 25 miles of steam, hot-water and sulfur lines reaching to wells and back to settling bins. One of the first things I did in taking over was to check those lines. I found that bum insulation and leaks on all that piping nose-dived my fuel efficiency. Some lines were poorly covered, or lagging was too thin. Many sections had weatherbeaten and damaged insulation, or it fitted so poorly it did little good.

"After a few weeks I had the purchasing agent send out bids for a few carloads of lagging. Before long word got around that the sulfur works' new chief was on a buying binge. And in no time a swarm of hungry salesmen made knots for our plant, like a school of hungry sharks.

"Most of these drummers were on the level, but one flashy peddler showed up who really took me for a sucker. After learning I was a marine engineer who graduated from a slice bar, he first

(*Continued on page* 180)

From routine water treatment reports and water sample analyses, experts at Nalco Laboratories keep a complete record of your plant water treatment — can assist materially in maintaining permanent water treatment security.

# How a *Nalco* WATER TREATMENT SERVICE AGREEMENT WORKS FOR YOU

OPERATION of your plant under a Nalco Water Treatment Service Agreement gives you two important safeguards against water treating problems in any form. First, Nalco will provide proper water treatment chemicals and procedures. Second, an experienced Nalco Service Representative will make regular visits to your plant, and is on call at any time to deal promptly with emergencies. Whether you have 10 or 10,000 BHP, this combination will provide what thousands of Nalco System users have learned to take for granted: *permanent water treatment security.*

Write, now, for full information on a Nalco Service Agreement for your plant.

*Nalco*

## SERVICE AGREEMENT SECURITY FEATURES

- **COMPLETE WATER TREATMENT SURVEY** of your plant by an experienced Nalco representative.
- **LABORATORY ANALYSES** of water samples . . . Initial complete analyses, followed by routine sampling and analyses as checks on plant tests.
- **RECOMMENDATIONS** of chemicals, testing and control procedures to establish water treatment security.
- **REGULAR CALLS** by a Nalco Representative to assure continuously successful treatment.
- **REPORT SYSTEM** to Nalco Laboratories gives cross-check on all phases of the Nalco System; enables keeping of complete performance records on your plant.
- **CONSULTING SERVICE** always available to assist in solving current problems — and in planning changes or additions to your plant which may affect water treatment.

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**6222 West 66th Place • Chicago 38, Illinois**

*Canadian inquiries should be addressed to Alchem, Limited, Burlington, Ontario, Canada*

**THE *Nalco*® SYSTEM • Serving Industry through Practical Applied Science**

# 40 reasons why **ANY** service requiring

## BRONZE GATE VALVES

can be planned for lasting economy

**SOLID WEDGE**

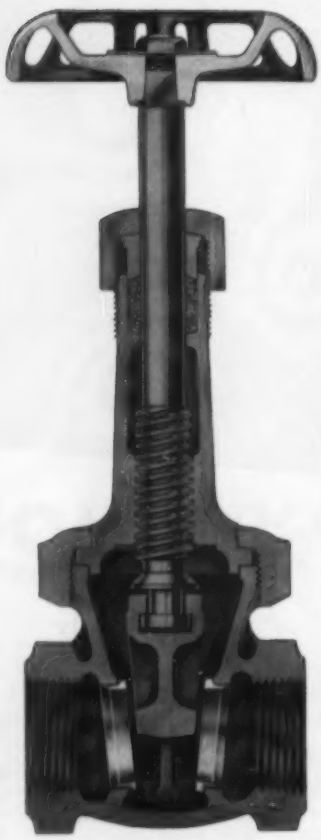
A variety of patterns for 125-150-200-300 and 350 lb. service, including Underwriters' Approved valves, also Solder End, Socket End, and Quick-opening Gates.

**SPLIT WEDGE**

Union bonnet, traveling spindle patterns for 125 and 150 lb. service. Also the popular SWINGTITE fast-action Lever Gate.

**MONEL SEATING**

For long-range economy in destructive services, the Jenkins line includes the 200 and 300 lb. valves illustrated (right). Available with MONEL rings and bronze wedge, or MONEL rings and nickel alloy wedge for exceptionally severe conditions.



JENKINS BRONZE GATES WITH MONEL SEAT RINGS

BRONZE WEDGE

| 200 lb. | 300 lb. |
|---|---|
| Fig. 270-U | Fig. 280-U |
| Fig. 270-UL | |

(U.L. approved for L.P.G. service)

NICKEL ALLOY WEDGE

| 200 lb. | 300 lb. |
|---|---|
| Fig. 270-UN | Fig. 280-UN |

Look over the list of 40 patterns in Jenkins complete line of Bronze Gates. You'll find the valve you need, and you can be sure it is built to provide the *extra value* that makes Jenkins the best buy for any service.

This new folder includes a handy chart for quick reference, and describes many features of the most popular patterns that assure easy maintenance and long wear. It's convincing evidence that the Jenkins line includes "a valve for every service" — valves that take top-rating in any test for endurance and economy.

You will want this up-to-date information on Jenkins Bronze Gates. Use the folder to plan your hookups for lasting economy.

**GET THIS NEW BRONZE GATE FOLDER** from your Jenkins Valve Distributor or write: Jenkins Bros., 100 Park Ave., New York 17. Ask for Form 181-C.

JENKINS VALVES

LOOK FOR THE JENKINS DIAMOND

SOLD THROUGH LEADING DISTRIBUTORS

...ERVICE---THERE'S A JENKINS BRONZE GATE
THAT WILL LOWER MAINTENANCE---LAST LONGER
40
DIFFERENT GATES TO VALVE SATISFACTION
125 lb. — 150 lb. — 200 lb.
300 lb. — 350 lb. PATTERNS
including
SOLID WEDGE
SPLIT WEDGE
INSIDE SCREW
OUTSIDE SCREW AND YOKE
STATIONARY SPINDLE
TRAVELING SPINDLE
SCREW-IN BONNET
BOLTED BONNET
UNION BONNET
QUICK OPENING
SOLDER END
SOCKET END
plus RADIATOR HOSE END and UNDERWRITER GATES
SOLID WEDGE TRAVELING SPINDLE
SOLID WEDGE SCREW-IN BONNET TRAVELING SPINDLE
SOLID WEDGE SCREW-IN BONNET STATIONARY SPINDLE
SPLIT WEDGE UNION BONNET TRAVELING SPINDLE
SOLID WEDGE UNION BONNET TRAVELING SPINDLE
SOLID WEDGE OUTSIDE SCREW & YOKE RISING SPINDLE
SOLID WEDGE OUTSIDE SCREW & YOKE RISING SPINDLE
SELECT THE GATE YOU NEED FROM THIS COMPLETE ASSORTMENT
SWINGTITE
FAST ACTION LEVER GATE
SOLID WEDGE BRONZE GATES
SPLIT WEDGE BRONZE GATES

# Reader service section

## *Your preview of things to come . . .*

### Looking for ideas?

Reader Service Section is crammed with them. Whet your appetite with the tidbits below – they're just a sample of the idea-packed pages that follow. Designed to help you get top value out of the section, this sampler will be a regular monthly feature. Watch for it, put it to work.

### More kw's in less space. . .

that's what makes fully supercharged generators the answer when you want to replace an old unit, increase plant output. And, if really big units are what you need, these new cooling methods push maximum output to 300,000 kw and larger. See Reports from the Field for details . . . . p 150

### Cut those pressure losses. . .

by designing ducts for top efficiency. A comprehensive report tells you how to go about it, points out pitfalls. Abstract in Technical Briefs summarizes this report, shows how to secure your copy . . . . . p 152

### An outside-in twist. . .

that's just one of the unique features of a dust collector introduced by American Air Filter Co. Trick twist reverses normal tangential flow found in most centrifugal designs; with inlet imparting swirl to dust particles, clean air travels through tube without changing direction. For facts and figures on this device, and many other improved products, see Plant Equipment News . . . . . p 156

### Ultrasonic fluxless soldering. . .

sounds interesting, doesn't it? For full information, send for the application booklet described on p 210. And for convenience in securing this publication, as well as others listed in Free Literature roundup, use the handy postcards . . . . . p 165

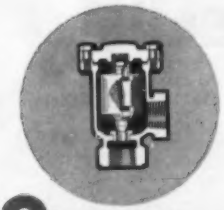
### Old friend. . .

to many engineers is W H McAdams' text on "Heat Transmission." Now along comes a new and revised edition in which old material has been simplified and data added. Read the notices of this and other new volumes in Engineer's Bookshelf to decide what to add to your information toolkit . . . . . p 226

***For other timely ideas, see following service pages ▶***

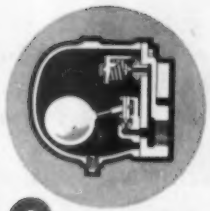
**1 Sarco Thermodynamic**

Valve head, a solid stn. st. disc, is only moving part. Same head and seat to 600 psi. Withstands superheat, water-hammer, corrosive condensate. Cat. 255-A



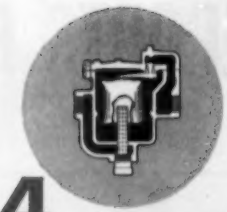
**2 Sarco Balanced Pressure Thermostatic**

Greatest capacity per dollar cost. Large air venting capacity. Same head and seat, 0-300 psi. Freeze-proof. Cat. 250-A



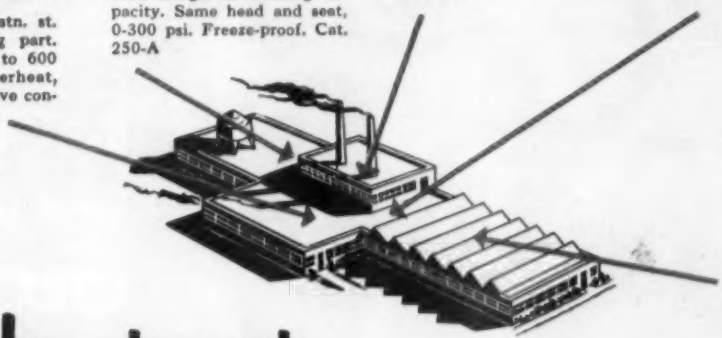
**3 Sarco Float-Thermostatic**

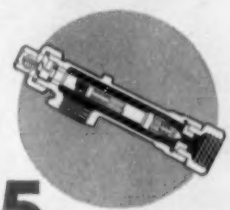
Discharges condensate continuously at steam temperature and without shock. Responds immediately to varying loads and pressures. Cat. 450-A



**4 Sarco Camlift Bucket**

New, powerful Camlift valve mechanism permits greater discharge with no increase in size of trap body. Cat. 360-A





**5 Sarco Liquid Expansion**

Adjustable to discharge condensate BELOW 212°F. Freeze-proof. Not affected by water-hammer or pressure pulsations. Cat. 260-A.

# How to get efficient steam trapping ...throughout your plant

**With these *5 Basically Different* Types of Sarco Steam Traps you can select the trap with the characteristics that match your *specific* job conditions.**

Just because a steam trap discharges condensate and air and closes to steam doesn't necessarily mean it's doing a good job. For maximum efficiency, a trap must also keep conditions within the steam spaces right for the heat transfer job to be done.

For example: A Bucket Trap will work on a unit heater—but its discharge is intermittent. Between discharges, condensate collects in the small steam space of the heater causing undesirable changes in air temperature. The continuous discharge Float-Thermostatic Trap will, however, keep the heating surface free from condensate *all the time*—insure uniform air temperature.

That's why no one type of steam trap can give best trapping results under all job conditions. And that's exactly why Sarco makes 5 *basically different* types of steam traps—each with a different set of operating characteristics.

**Solve Your Trapping Problems**

And because Sarco makes all 5 types—not merely variations of one type—you can always get *impartial* advice from Sarco, based on over 43 years of field experience. Write to your local Sarco representative or to Sarco Company, Inc., Empire State Building, New York 1, N. Y.

**ONLY SARCO makes all 5 types of steam traps**

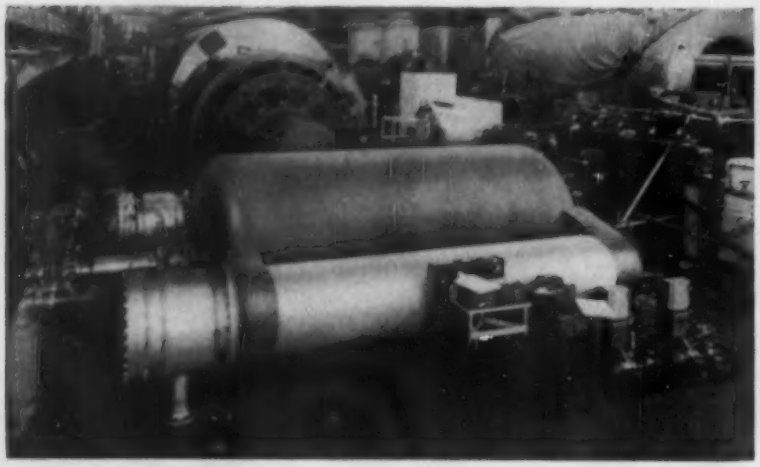
*—not merely variations of one type!*

S110C

# REPORTS FROM THE FIELD

***What's happening in power and what it means to you***

For Calendar of Events see page 222



**SPACE SAVING** is one feature of this supercharged generator shown here under test

## Fully supercharged generator unit passes shop-test milestone

► THE NEW Allis-Chalmers fully supercharged generator has moved through the shop-test milestone, and with flying colors. In some respects machine behavior has exceeded earlier predictions. A prototype of 3600 rpm machines that can now be rated 300 megawatts and larger, it embodies many new features permitting full utilization of the newest cooling principles. For a roundup of design features used with supercooled generators, refer to POWER, April 1954, page 158.

**Test results** indicate that at 5 psig the full 47 mva load can be carried without reaching accepted temperature limits on either rotor or stator. Nearly 80% overload at 70 psig is needed to get hottest part of generator copper up to the 130 C limit. At all pressures and loads, rotor hot-spot temperature is below that of stator.

Embedded resistance detector, placed between coils at hot end of machine, showed a rise of 75 C while maximum strand rise at same end measured 81 C at this load. This difference of only 6 C between maximum embedded resistance detector temperature, and copper temperature in the same region, was virtually constant at all pressures both at 47 and 60 mva. This confirmed earlier conclusions, that by means of separate axial cooling ducts in stator core copper and iron can be kept at nearly the same temperature.

Short-circuit-ratio (scr) is 0.83 at the nominal 40 mw rating. This more than meets requirements of the preferred standard design.

**Completely supercharged** generator was designed and rated to have a full-load efficiency equal to that of the conventional machine. However, test data indicates that with gas pressure controlled to provide a hot-spot temperature 10 C below accepted standard for Class B insulation, supercharged generator will be more efficient at all loads.

Because of the cooling design used with this machine, safe temperatures are not exceeded even at low hydrogen pressures. Efficiency at all loads, including full load, can therefore be further improved by taking advantage of windage loss associated with lower gas density at low pressure. Generators of this type,

(*Continued on page* 220)

## Coil insulation life increased 50%

► COIL INSULATION with 50% longer life than conventional systems is now becoming available on General Electric induction motors of 100 to 3000 hp ratings. Described by GE engineers as the most significant development in form-wound insulation in 50 yrs, the new *Polyex* insulation increases dielectric strength by 50% and mechanical strength by 600%.

For the first time, materials in an insulation system are natural insulators in themselves, the engineers said. Previous systems have had cotton or paper bases, that in themselves are not insulating materials.

Resistance to contaminants, shown by salt water immersion tests, is at least twice that of conventional insulation, the engineers claimed. Other tests showed the coil power factor of *Polyex* insulated coils to be substantially lower because of its tighter, more homogeneous character.

## Hydroelectric power facilities planned by Alcoa

► ALUMINUM COMPANY OF AMERICA, under an agreement with the Tennessee Valley Authority, plans to build a new dam and hydroelectric power generating station on the Little Tennessee River.

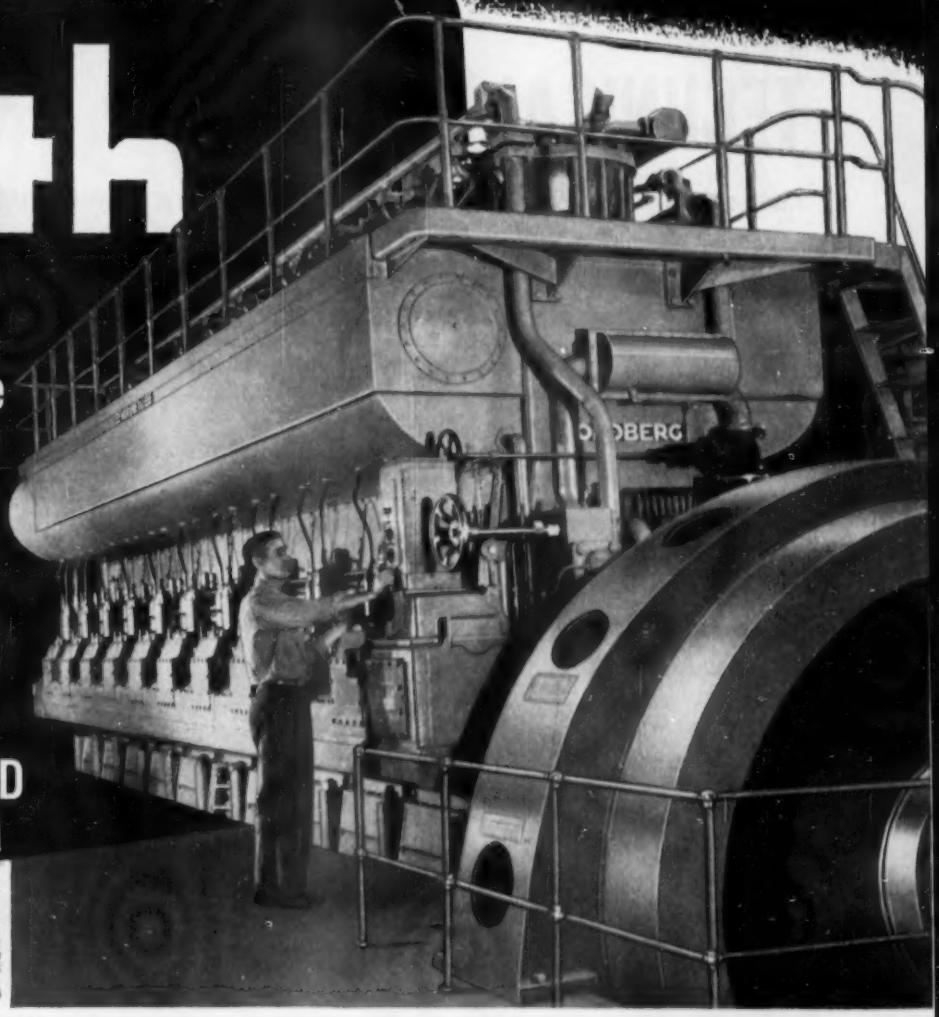
The dam, to be operated at a point known as the Chilhowee site in Blount and Monroe Counties, Tennessee, will have maximum height of 82 ft and a length of approximately 1400 ft. It will create a reservoir about nine miles long, extending upstream to Alcoa's present Calderwood powerhouse. Electric power made available by the new facilities will be used for aluminum smelting and fabricating at the company's Alcoa, Tenn. works.

The powerhouse, to be constructed at the dam site, will include three generating units having total capacity of 70,000 hp. Cost of constructing the dam and

(*Continued on page* 220)

# 4th

## NORDBERG Duafuel® Engine helps Garland, Texas keep pace with INCREASED POWER DEMAND



• One of the fastest growing towns in the United States, Garland, Texas is composed of over 17,000 progressive minded citizens. Just 14 miles northeast of Dallas, Garland is located in the heart of the north Texas rich blackland farming region.

In keeping with this rapid growth, and with an eye to the future, responsible officials have made sure that Garland's power plant has maintained a steady increase in capacity, to meet the ever-increasing power demand.

Backbone of Garland's efficient, economical power generation facilities are four reliable Nordberg Duafuel® Engines, installed at intervals to meet the increasing demand. The most recently installed unit is a 2-cycle, 10-cylinder Nordberg low pressure Duafuel® engine rated 4,580 hp, 3,500 kw, at 240 rpm. This fourth Nordberg repeat order was preceded by another 2-cycle low pressure Duafuel® unit rated 3,010 hp, 2,100 kw . . . and two 4-cycle supercharged Duafuel® engines each rated 1,200 hp, 855 kw.

Today, with four dependable Nordberg engines capable of generating over 7,000 kw, citizens of Garland can point with pride at the continued growth of their city and its power facilities.

*Next time you are thinking of power, think of Nordberg . . . builder of America's largest line of heavy duty engines, from 10 to over 10,000 horsepower.*

**NORDBERG MFG. CO., Milwaukee, Wis.**

# NORDBERG

DIESEL • DUAFUEL® AND SPARK-FIRED GAS ENGINES

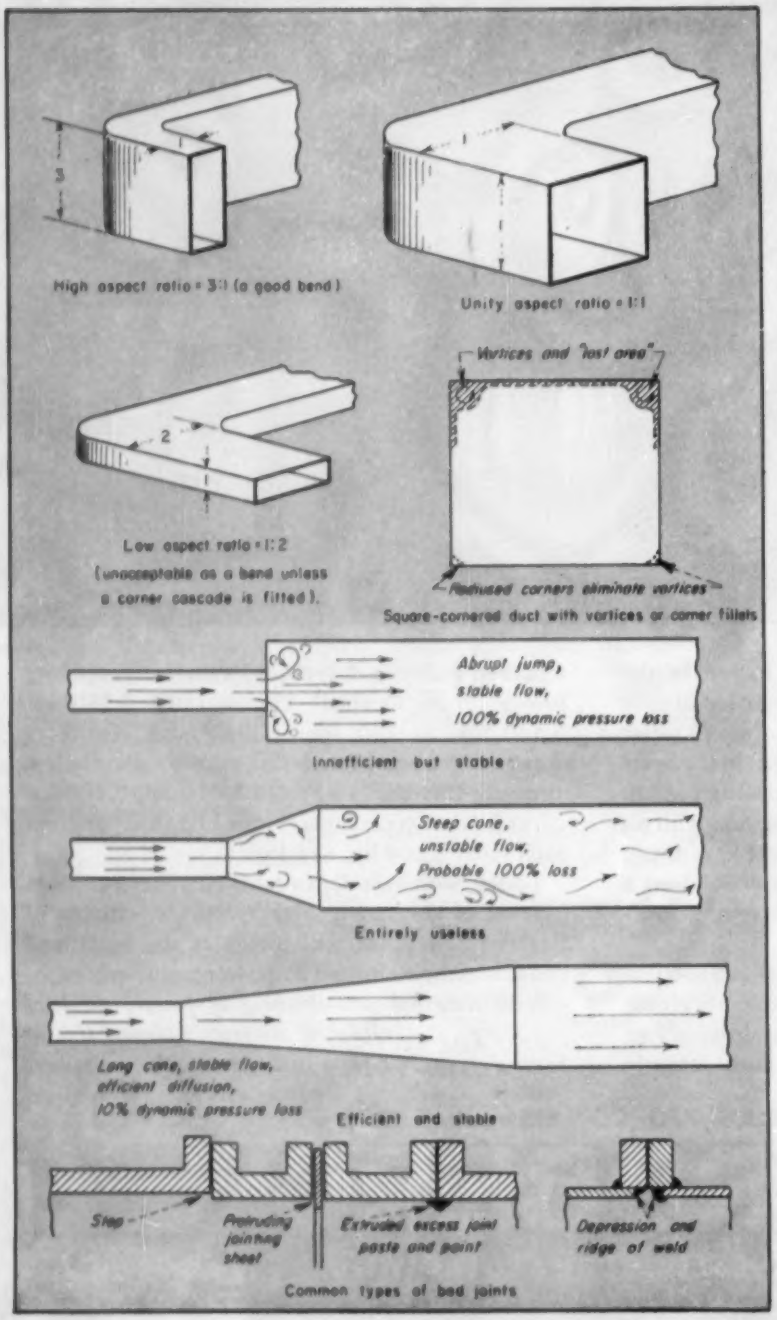
9734

# TECHNICAL BRIEFS

***Latest engineering developments for busy power men***

**8 Digests for you on:**
**DUCTING**
**ENGINES**
**BOILERS**
**ELECTRICITY**

## Useful tips for plant duct design




**The design of power plant ducting.** *By H S Fowler, National Research Council of Canada.*

Transfer of mechanical power from one point in an engine to another by shafts, gears, bearings, etc., has long been considered an important subject and much care has been devoted to it, both in design offices and shops. Transfer of working fluids like air, steam and gas has, however, been neglected as of little consequence. Duct work, particularly internal ducts cored out of castings, is treated simply as a set of cross-sectional areas to be wrapped around the mechanical components as closely as possible, with little regard for flow.

Now that high efficiencies are imperative, particularly in advanced steam sets and in gas turbines, this state can no longer be tolerated. An understanding of the laws governing gas flow is needed and some rationalization of the design of ducts is essential.

Design can then be carried out with a firm aerodynamic basis to match the existing knowledge for design of mechanical parts. Some of this understanding conveyed to the shop would help reduce the lack of interest often displayed in the internal finish of ducts and passages. Poor mating, careless jointing and rough finish take a toll.

In speaking of power-plant ducting, this report considers not only the pipework frequently covered by this term, but any enclosed space in which fluid flows. The data therefore apply to aerodynamic design of turbine and compressor inlet and delivery volutes, combustion chambers, condenser shells, and other such parts, as well as pipe ducts.

The report covers theoretical basis of design, including total pressure loss and loss-factor, stability of flow, distribution and equilibrium, and distribution of air flow in a system. Practical design is covered in terms of total pressure loss factor, straight ducts, accelerators, diffusers, bends, ducts forming parts of components, valves and throttles. Appendices cover aerodynamic formulae and values, Reynolds' number, Mach number, loss-factor calculation, etc. *NRCC report no. ME-208.*

*This helpful new booklet tells you*

# How flange surfaces affect gasket performance

IF YOU BUY, specify or design joints requiring gaskets, you will find helpful information in this new booklet. It provides a basis for selecting the flange surface finish most suitable for a given gasket. It explains why the right finish makes it easy to form the initial seal and obtain the best joint performance in service.

This booklet is the latest in a series of technical publications issued by Johns-Manville under the collective title "The Gasket." It is based on studies made at the Johns-Manville Research Center, largest laboratory of its kind in the world. It incorporates the long experience of Johns-Manville engineers in the design of gaskets such as asbestos, fibre and composition types, asbestos-metallic and all-metal gaskets.

**Booklet offered without charge**

To secure your copy of this study, write for "The Gasket," PK-48A No. 7. Address Johns-Manville, Box 60, N. Y. 16; in Canada, 199 Bay St., Toronto 1, Ont.

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**Johns-Manville PACKINGS & GASKETS**

# More TECHNICAL BRIEFS

Begins on page 152

## Internal-combustion engines

**High supercharging development of a GM 16-278A 2-stroke cycle diesel engine.** *By W G Payne and W S Lang, U.S. Naval Engineering Experiment Station, Annapolis, Maryland.*

There are diesel engines commercially available in Europe with brake mean effective pressures far exceeding any in this country. The chart shows the rating of some of those engines in comparison with representative American diesels.

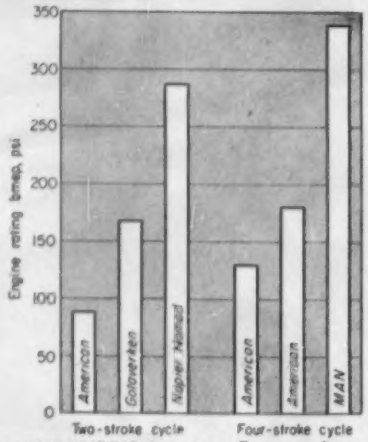
The two-stroke cycle section includes the Gotaverken opposed-piston engine with a continuous rating of 150 psi bmep and a maximum rating of 168 psi bmep. The rating was attained with a supercharging pressure of 20.8 psig, obtained with an exhaust-driven turbocharger. The Napier Nomad, by using its exhaust energy both to drive a turbocharger and to provide added crankshaft power, has an output of 287 psi bmep with a supercharging pressure of 75 psig. In comparison, our most comparable American diesels have outputs not exceeding 90 psi bmep.

The MAN engine shown in the 4-cycle section has a similar differential over the available American engines in comparable sizes. There, use of supercharging pressures to 32 psig, with a 2-stage exhaust-driven turbocharger and an intercooler between stages, permits an output rating of 312 psig bmep with a high thermal efficiency. Comparatively, American engines are available at a maximum of about 180 psig bmep.

The project described in this paper was conducted to show power increase that could be made in a 2-cycle diesel of normal design without extensive or radical changes in the engine. A theoretical analysis indicates that a charging air system using an exhaust-driven turbocharger, engine-driven Roots-type blower and an aftercooler would permit increasing engine output from 1600 to 3000 bhp at 750 rpm. Using a mechanism to control engine compression ratio relative to engine output would further improve thermal efficiency at lower loads. *SAE paper no. 402.*

**Application of starting fluids to internal-combustion engines.** *By W G Ainsley and H D Young, Sinclair Research Laboratories, Inc.*

Fluid-type starting aids have been widely used since World War II for starting diesel and gasoline engines at




**COMPARISON;** American, European bmep

temperatures ranging from + 50 F to −40 F, or lower. Despite this relatively long period of use, technical literature is devoid of information to guide the user in effective utilization of these fluids.

Fluid aids represent one of the most, if not the most, promising methods for starting internal-combustion engines, particularly diesel engines, in cold weather. No cumbersome accessory equipment is required and, when properly applied, relatively small quantities of fluid achieve a start and sustain operation.

Starting fluids are only effective when the engine can be cranked at some reasonable speed for a short period of time. Minimum cranking speed for a diesel is about 80 rpm; for a gasoline engine it is about 50 rpm.

These studies show, among other things, that it is possible to formulate starting fluids which retain the advantages of straight di-ethyl ether but have none of its disadvantages. Suitably formulated starting fluids plus an applicator that can be adjusted to fit engine requirements without necessity of operator know-how provides a reliable and effective means of starting engines in cold weather. *SAE paper no. 400.*

**Effect of low ambient temperature on cranking and starting of diesel engines. Part 1: Engine starting tests.** *By J F Blose, U.S. Naval Engineering Experiment Station, Annapolis, Maryland.*

Studies over more than 20 years show that the ability of an engine to be started at low temperatures is influenced by many factors including engine design, maintenance, type of cranking system, type of starting aid and properties of the fuel and lubricating oils.

Directions for ordering papers on p 218

Engine design influences starting ability through the effect of compression ratio, combustion-chamber design and valve timing on the pressure and temperature in engine cylinder at end of the compression stroke. Fuel-injection system design controls dispersion and penetration of the fuel spray. Flywheel's moment of inertia must help the starting motor maintain a uniform cranking speed as each piston passes through top center.

Engine maintenance influences starting ability through the effect of worn piston rings and cylinders and distorted valve seats on compression pressures. Worn fuel-injection equipment adversely affects the rate and quantity of fuel injected into each cylinder.

Of the many cranking systems used, the electric-motor and air-motor systems were more bulky and heavy, but gave a longer duration of cranking than the others, providing an opportunity to correct minor malfunctioning or maladjustments before the cranking system was discharged.

Generally speaking, 12-v electrical systems were none too adequate at subzero temperatures and use of 24-v systems is recommended. Flame primers, glow plugs and many ways of ether fluid application were found effective starting aids at these temperatures.

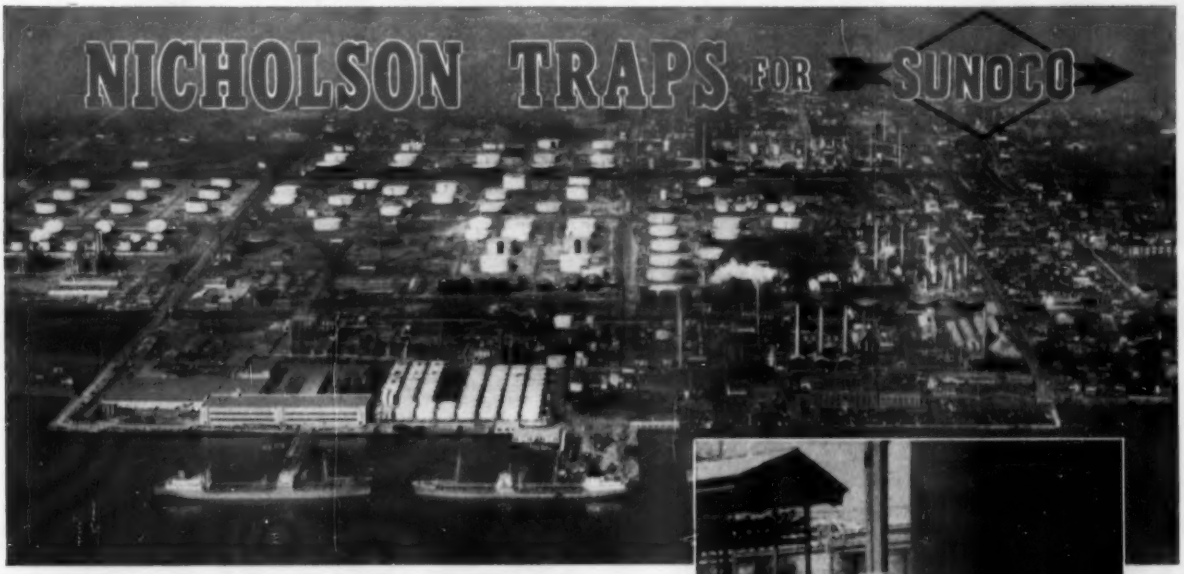
**Part 2: Effect of oil viscosity on cranking requirements.** *By J P Qualey, J T Duck and L G Schneider, U.S. Naval Engineering Experiment Station, Annapolis, Maryland.*

Three oils were selected for these tests. One was SAE 30, the other two were low-viscosity blends. Test results show oil viscosity is the major factor in determining low-temperature cranking requirements of a diesel engine.

Oil-film shearing causes a significant temperature increase in the bearing area and to a lesser extent on the cylinder-wall surface. No appreciable change in crankcase temperature occurs during normal cranking periods.

A rapid decrease in torque during the first minute of cranking appears to be associated with viscosity changes resulting from increased temperatures. Breakaway torque does not change appreciably with oil viscosity or temperature. Oil flow is restricted by high viscosity. Little or no flow occurs below the pour point. *SAE paper no. 399.*

(*Continued on page* 214)




*Air view of Sun Oil Company's refinery at Marcus Hook, Penna.*

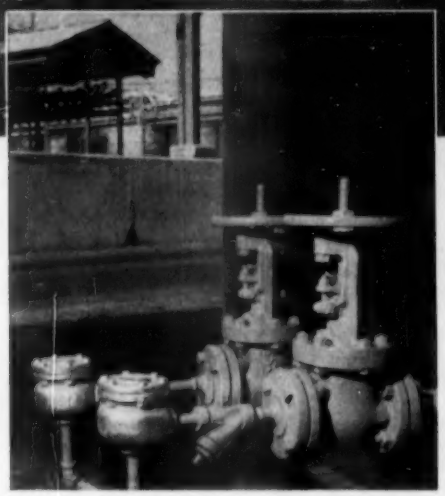
**Standard for**

**OUTDOOR USE**

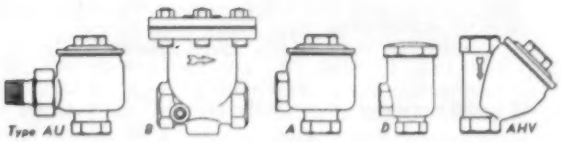
**Due to**

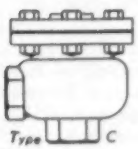
**FREEZE-PROOF**

**Feature**



Nicholson steam traps are shown above installed on storage tanks requiring heating at Sun Oil Company's Marcus Hook, Pa., refinery. Sun has standardized on this type of installation.




SIX TYPES FOR PROCESS, HEAT AND POWER -- Construction of bronze, semisteel or cast steel. In sizes of ¼" to 2" for pressures to 300 lbs. All six types of traps have stainless steel valves and seats. Bellows are furnished in bronze, monel or stainless steel.

**W. H. NICHOLSON & CO.**

**TRAPS · VALVES · FLOATS**

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Sales & Engineering Offices in 58 Key Cities

# PLANT EQUIPMENT NEWS

***Your information center for new products designed to solve plant problems***

Published monthly as a service to readers

### Dry chemical extinguisher weighs 22 lbs

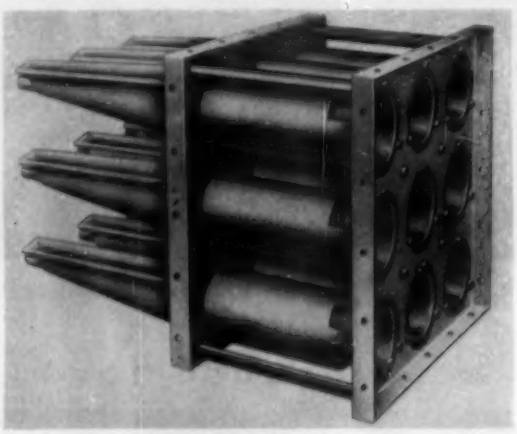
**101** • Streamlined fire extinguisher, designed primarily for industrial use, is capable of expelling 10 lbs of dry chemical. This is claimed by the manufacturer to be the latest and most effective extinguishing agent against fires in flammable liquids, gases, chemicals and electrical equipment. Overall weight of the unit is only 22 pounds.

Design feature is elimination of ring-pin previously used as a safeguard against accidental discharge. Now user applies additional hand pressure to puncture the $CO_2$ pressure cartridge that activates extinguisher.

Other design changes claimed are: fill cap that is considered more effective in keeping moisture out of extinguisher shell, a carrying handle that is less subject to vibration on vehicles, and an easy-to-operate squeezable nozzle.

Entire unit has approval of the National Board of Fire Underwriters. Designed by Raymond Loewy Associates, it will be introduced on February 1st.

**Ansul Chemical Company, Marinette, Wisconsin**



### Dry centrifugal granular dust collectors

**102** • Dry granular dust collector is recommended for power plants burning pulverized coal, and rock products, and dry chemical plants using large volumes of exhaust air. Unit utilizes an outside-in twist that reverses the normal tangential flow of most centrifugal dust collectors. A conical inlet that imparts a swirling motion to dust particles permits clean air to travel through the tube without changing direction. Each tube has approach velocity of 1000 fpm and cleaning capacity of 333 fpm.

Nine tubes are combined in a standard modular cell that has a nominal rating of 3000 cfm with face area of 20x20 in. Any number of modular cells may be combined to achieve required capacity within available space.

Manufacturer claims that because of this "straight through" air flow design unit can handle widely varying air volumes and dust concentrations with almost constant efficiency. This is a factor in eliminating flyash during boiler blowoff.

**American Air Filter Co, Inc, Louisville 8, Ky.**

For more data on these items, use post cards page 165. Identify your request with item number.

### Supervisory control system

**103** • System is designed for both remote measurement and for such control functions as remote shaft positioning, off-on switching and proportional control. Called *Electro-Span*, system may be used in conjunction with any electrical transmission medium.

The system provides remote electrical measurement of liquid level. It allows selection of a given tank, tank self-identification and transmission of level information in ⅛-in. increments to 60 ft. Information, coded in digital form, is transmitted on a two-wire telegraph circuit from remote tank location to the central control station via the remote tank selector. Request details.

**Bendix Aviation Corp, 11600 Sherman Way, N Hollywood, Calif.**

### Motor speed controls

**104** • Unmounted motor speed controls are designed for assembly into other equipment, such as conveyor drives, winders, lathes and machine tools. All parts except the speed control element are mounted on a metal chassis with connection brought out to a terminal strip. Various circuit arrangements can be used for reversing, dynamic braking, etc.

Units are used for operating dc shunt or compound motors from ac power lines. Advantages claimed are wide speed range, smooth adjustment, high starting torque, quick reversing, no torque pulsation and low maintenance. Capacities range from 1/15 to 1½ hp.

**General Radio Co, 275 Massachusetts Ave, Cambridge 39, Mass.**

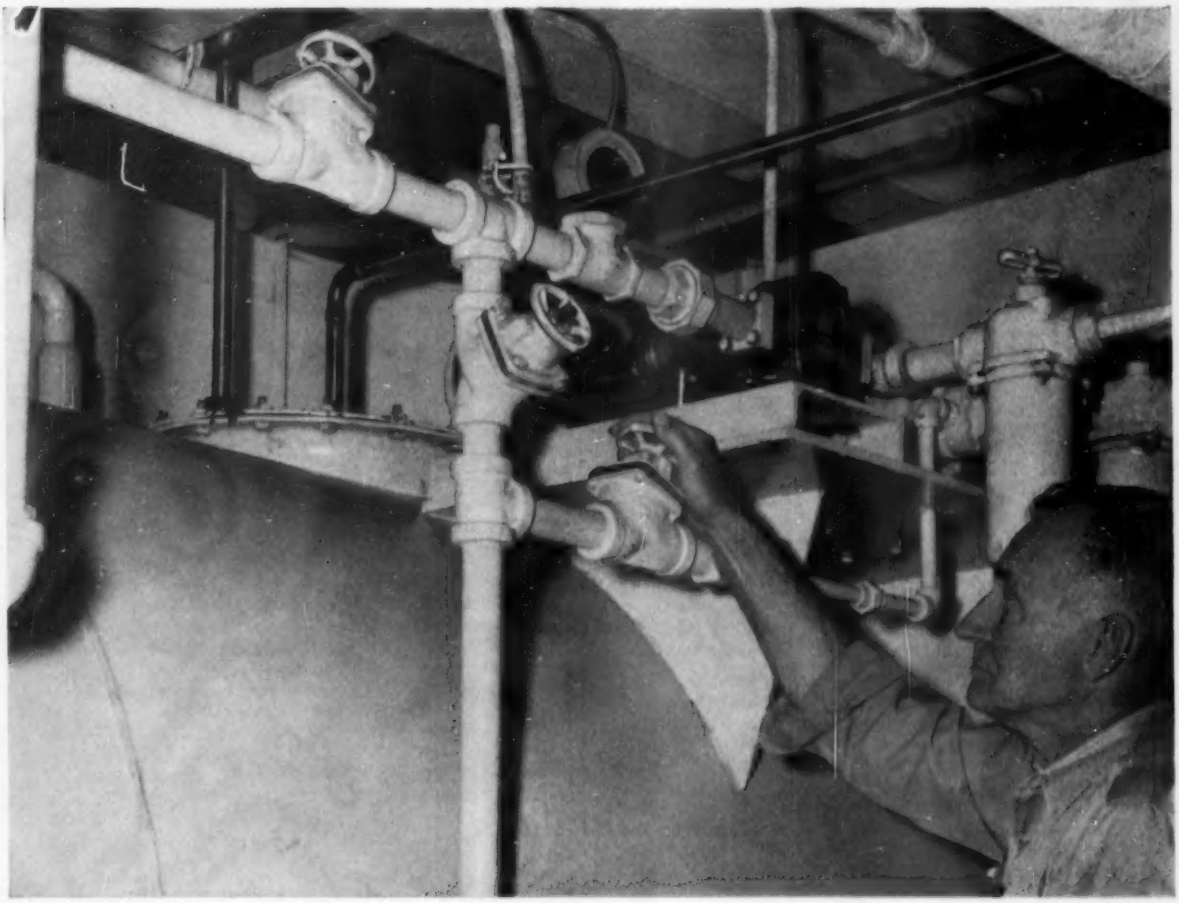
### Dissolved oxygen analyzer

**105** • Analyzer is designed for continuous measurement of dissolved oxygen in boiler feedwater. Designated as *Model 2B2B* it consists of a sample flow regulating and ion exchange unit, analysis unit and a modified recorder.

Principle of measurement is based on oxidation of nitric oxide, NO, in water solution by dissolved oxygen to nitrogen dioxide, $NO_2$, which in turn reacts with the water to form nitric and nitrous acids.

Range of analyzer is 0-20 parts per billion adjustable to 0-200 parts per billion. Accuracy, according to manufacturer, is 5% of the reading. Complete information available on request.

**Arnold O Beckman, Inc, 1020 Mission St, S Pasadena, Calif.**



# Light oil meets its master in these CRANE VALVES

**THE CASE HISTORY**— Read how the Johnson & Johnson baby products plant at Cranford, N.J., completely stopped a valve leakage condition that wasted product . . . caused a safety hazard . . . and menaced the plant's high sanitation standards.

Valves formerly used on very light baby oil lines were the source of trouble. Keeping them tight at the stuffing box was next to impossible. Constant servicing of stuffing boxes was necessary, even after repacking every 4 to 8 weeks. Several packings were tried without success while the high maintenance costs and nuisance conditions continued.

Early in 1951 the plant found the solution in Crane No. 1610 Packless Diaphragm Valves. They removed the cause of leakage —immediately stopped its troubles and costs. Almost 4 years later—with no maintenance whatsoever—the Crane packless valves remain absolutely tight; continue giving perfect service. And that goes for all valves added since the first installation.

## Crane No. 1610 Packless Diaphragm Valves

When you have valve problems with hard-to-hold fluids, try Crane *Packless* diaphragm valves. They eliminate stem leakage and maintenance on air, vacuum, gas, light oil and similar services. Their diaphragm has longer life, yet should it fail, their separate disc prevents escape of line fluid. Available in wide selection of materials and sizes. Ask for folder AD-1942 or see your Crane Representative.

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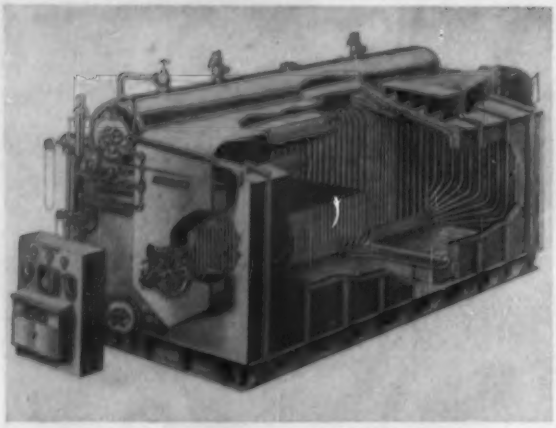
**VALVES • FITTINGS • PIPE • PLUMBING • HEATING**

**CRANE'S FIRST CENTURY . . . 1855-1955**

# More EQUIPMENT NEWS

Begins on page 156

## Packaged boiler units

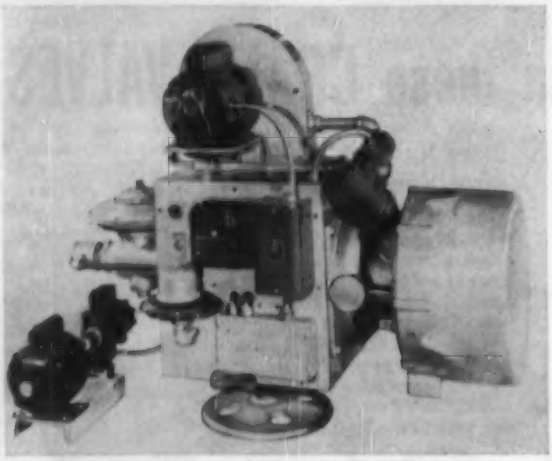


### Steaming capacity to 40,000 lbs per hr

**109** • These packaged steam generators are designed for firing with gas, a variety of fuel oils, or both. Units, performance-rated at capacities to 40,000 lbs per hr continuous steaming, may be combined in batteries for any required total capacity.

Claimed features include rear-mounted forced draft fan providing air cooled furnace roof, tangent tube waterwall construction, single or multi-burners, optional soot blowers and an air shielded observation port. Full information on request to manufacturer.

**Superior Combustion Industries, Incorporated, 1475 Broadway, New York 36, New York**



### Burner for firing rates to 3,000,000 Btu

**110** • Completely packaged unit includes blower, burner, oil pump with motor, built-in tuyere, air/gas mixer, safety equipment, transformers, valves, regulators, filter, piping and wiring. Unit can be used with gas and light oil, oil, or gas for automatic off-on firing of steam boilers, water heaters, air heaters, industrial ovens, etc, at firing rates to 3,000,000 Btu.

Snap-switch control on side panel of burner changes fuel automatically. No mechanical or electrical changes are required. Unit has UL approval. Complete data in bulletin R-100.

**Eclipse Fuel Engineering Co, Buchanan St, Rockford, Ill.**

To obtain additional information on these new equipment items, use the post cards on page 165. Identify your request with item number.

### Rupture-proof gasket construction

**111** • *FreeFlow* gaskets are claimed to eliminate flow restriction and turbulence in the line, as well as danger of gasket rupture at high temperatures.

Inner periphery is of "channel" construction designed so it does not extend beyond I.D. of pipe to cause throttling action. Manufacturer states that this construction assures full contact with pipe flanges and allows insert to extend to full depth of gasket envelope, thereby eliminating an air space. Chemically inert *Teflon* envelope makes gasket adaptable to corrosive services and temperatures from −100 to + 482 F, depending upon insert material.

Manufacturer recommends these gaskets for service in glass lined, porcelain and pyrex equipment, including reactor kettles and pipes, distillation columns and nozzles. Complete information obtainable from Dept. PRN.

**Crane Packing Co, 1800 Cuyler Ave, Chicago, Ill.**

### Water treatment unit cuts make-up cost

**112** • Water treatment device is to be used where water or boiler conditions do not justify installation of expensive mechanical proportioning equipment to treat boiler make-up water. Unit avoids excessive feed pump wear by introducing water treatment compounds on discharge side of boiler feed pump. This is claimed to eliminate pump wear usually caused by abrasive materials in powdered water treatment compounds. Tank capacity of unit is two gallons. Boiler feedwater can be introduced through tank containing a previously measured amount of water treating compound, or it can feed straight through from feed pump to boiler, by adjusting three valves. Full details on request.

**Cyclotherm Div, U.S. Radiator Corp, Oswego, N. Y.**

### Plug seals off leaky condenser tubes

**113** • Unit consists of two pieces; a brass bushing with collar that is a close fit in the tube (its size must be specified as the tube inside diameter at the expanded section); and a steel plug, made with a slight taper to fit inside taper of the bushing. This tapered plug is driven into the bushing. Expansion of bushing or sleeve makes a tight fit, sealing leaky tube. No damage can be done to the tube sheet. The device accomplishes parallel expanison and gives complete contact of sleeve with tube. Complete information on request to the manufacturer.

**Lagonda Division, Elliott Co, Springfield, Ohio**

### Acid- alkali-resistant black paint

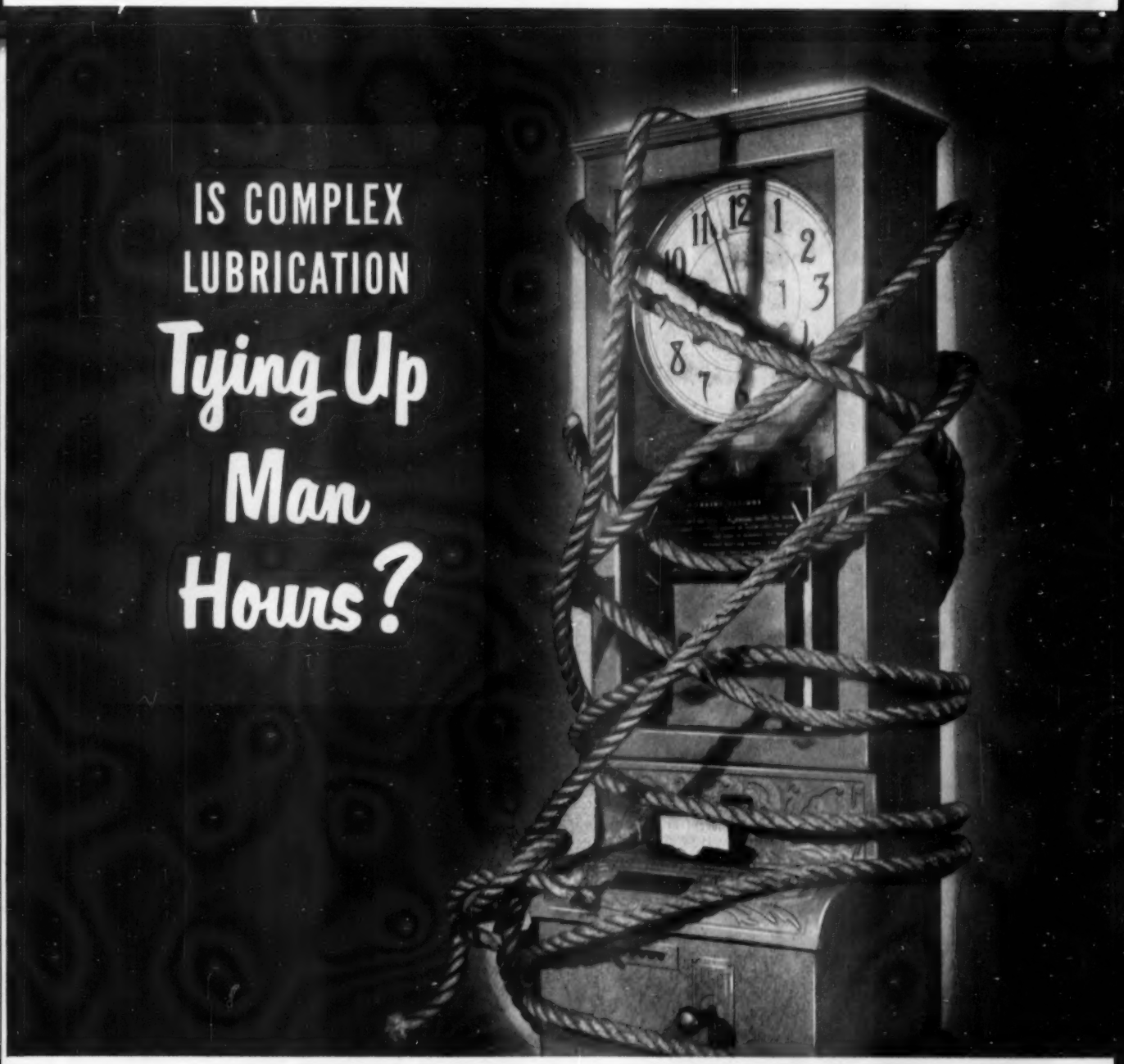
**114** • Improved *Chem-Rem* acid and alkali-resistant black paint is claimed to make possible one coat coverage, rather than the multi-coat process previously recommended. Manufacturer reports *Chem-Rem* withstands attacks of acetic and hydrochloric acids, dilute sulphuric acids, bleaching solutions, dilute caustic soda, ammonia and other alkalines. It is recommended for both interior and exterior use on metal, masonry or wood, and for locations where smoke and chemical fumes are prevalent. Applications include tanks, ventilating hoods, pumps, conveyor arms, roofs and siding, piping and towers. Further details on request.

**Speco, Inc, 7308 Associate Ave, Cleveland 9, Ohio**

### Mobile 45-kv dc high voltage test set

**115** • Unit is designed for plant and laboratory use in testing wire and cable rated to 15 kv, rotating machinery, insulating materials, etc. Output voltage is 0-45 kv read on a voltmeter connected directly across the output with ranges of 0-15, 30 and 45 kv. Full details on request.

**Associated Research Incorporated, 3758 W Belmont Ave, Chicago, Ill.**

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Sales offices located in more than 500 cities in Pure's marketing area

# More EQUIPMENT NEWS

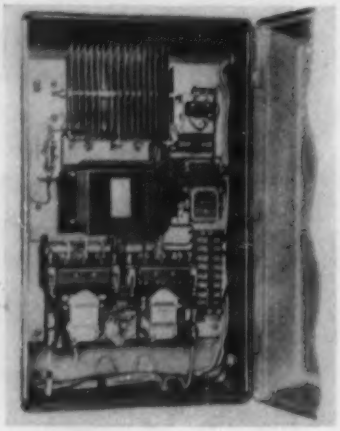
Begins on page 156

## A full page of electrical products for your review

### Insulation testers

**120** • Two rectifier-operated units; one having range to 100,000 megohms at 5000-v dc with 1000 v and 2500 v intermediate range; and one having range to 200,000 megohms at 10,000 v with no intermediate voltage ranges, are now available. High range permit field tests on bushings, generators, transformers and cables. Request bulletin 21-20-24 for complete information.

**James G Biddle Co, 1316 Arch St, Philadelphia 7, Pennsylvania**



### Dc braking controller

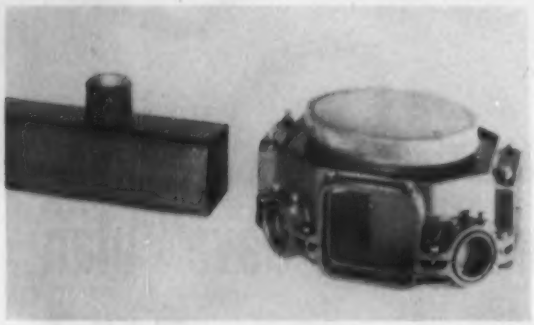
**121** • Unit is available in two sizes of enclosures for braking standard induction motors from ¼ to 25 hp. Controller is said to provide braking torques to eight times full load running torque. Operated from a single start-stop push-button, unit requires no adjustment after initial installation. Main components are selenium rectifier, contactors, transformer and timing circuit.

**Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.**

### 400-amp circuit breaker

**122** • Unit is claimed to be first designed to bridge the gap between present 225-amp frame molded case circuit breakers and 600-amp models. Interchangeable trip units provide continuous rating versatility from 125 to 400 amps. Uses include switchboards, motor controls, panelboards, bus duct plugs and individual enclosures. Dimensions are 9-in. wide, 15½-in. high, 5½-in. deep.

**I-T-E Circuit Breaker Co, 19th & Hamilton Sts, Phila. 30, Pa.**



### Four-inch underfloor electrical raceway

**123** • Industrial-type underfloor electrical raceway is designed for heavy-duty wiring in plants where overhead wiring would interfere with normal operations. Manufacturer claims this 14-gage cold-rolled steel unit with 4x4-in. cross-section has three times the capacity of standard underfloor ducts.

Unit is galvanized by the sherardizing process and is further protected with acid-resistant clear enamel on interior and exterior surfaces, according to manufacturer. The raceway is furnished in standard 10-ft lengths and provides two-in. pipe size; threaded outlets on 24-in. centers permitting direct insertion of conduit for standpipe service fittings.

The fully grounded unit comes complete with junction boxes and fittings. U.L. approved. Full information on request.

**National Electric Products Corporation, Gateway Center, Pittsburgh, Pennsylvania**

### Three features added to 600-v transformers

**124** • Manufacturer claims three improvements to *type JKP-O* 600-v current transformers. Accuracy of the 200-amp-rated model is now 0.3 B-0.1 and 0.3 B-0.2.

Window size increased to 1 11/16-in. diameter permits use of larger primary cables with amp ratings commensurate with transformer rating.

Third feature is a primary-bar unit that can be inserted in transformer window. Full details on request.

**General Electric Co, Schenectady 5, New York**

### Grounded 3-wire extension cord sets

**125** • Shockproof, grounded 3-wire U-blade extension cord set is designed to meet new grounding requirements put into effect on January 1st. Unit accommodates 3-wire caps that will be components of many portable tools and appliances.

Claimed features of the set are armored cap and connector with metal cord clamps and No. 16-3 *type S.J.* heavy duty wire. Available in 10, 25, 50 and 100-ft lengths. U.L. approved.

**Rodale Manufacturing Co, Inc, Emmaus, Pa.**

### Fused caps fit standard receptacles

**126** • Fused plugs designed for use with all types of portable or stationary tools and appliances use standard NEC cartridge fuses. Manufacturer states units assure maximum contact with fuse ferrule, eliminating heating due to poor contact, thus assuring uninterrupted service and proper selection. Unit is easily assembled—one screw is removed to insert fuses or for wiring. Individual fusing prevents outage of other devices on same circuit. Full details in bulletin 400, available on request.

**Novelty Electric Co, 10th & Cherry Sts, Phila. 7, Pa.**

For more data on these items, use post cards, page 165. Identify your request with item number

## One of many advantages of 90/10 Cupro-Nickel

# WELDABILITY

Welding head on filter shell

One of the relatively new copper base alloys is 90/10 Cupro-Nickel, which is coming into increased use as a result of experience with it. Revere offers it in sheet and plate, pipe and tube. It is highly resistant to corrosion and erosion, particularly in salt or brackish water. In addition it can be cold or hot worked, welded, soldered and polished. Because its nickel content is less than the older 70/30 alloy, it is priced lower.

The item shown here is a 90/10 Cupro-Nickel filter for aviation gasoline, designed and fabricated by the Warner Lewis Company, Division of Fram Corporation, Tulsa, Oklahoma, for the U. S. Navy. Heads and shell are 1⅛" thick. Revere was given the opportunity to collaborate with the Warner Lewis manufacturers on welding, which was successfully accomplished by the metallic arc process, using Inco 70/30 Cupro-Nickel electrodes. The vertical weld on the shell was X-rayed 100% and found satisfactory to pass Navy inspection. Because of the thickness of the metal, it was decided to form the heads hot at around 1690° F. The forming was done by the Hackney Iron & Steel Co., Enid, Okla., which also consulted with Revere.

Warner Lewis Company of Tulsa, with representatives in 30 cities, are specializing on all types of alloy design and fabrication and inquiries of this nature are invited.

If you wish information regarding the selection, welding, or working of copper and its alloys and aluminum alloys, see the nearest Revere Sales Office.



Completed aviation gasoline filter, made of 90/10 Cupro-Nickel

**REVERE**

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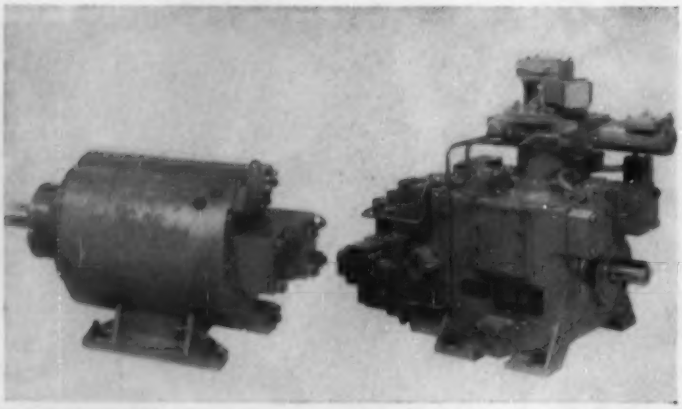
# More EQUIPMENT NEWS

Begins on page 156

## Three recent transmission developments



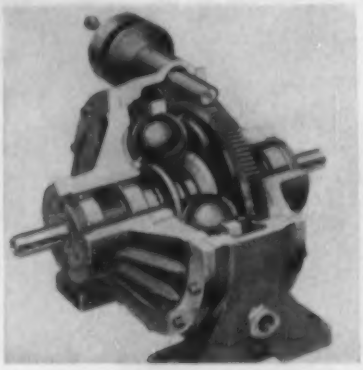
### Hydraulic transmission for operating pressures to 3000 psi

**106** • Unit consists of a 112 gpm variable and reversible delivery axial piston pump and a constant displacement axial piston motor. Transmission is designed for operating pressures to 3000 psi.

Designed primarily as a winch and hoist transmission other applications include drives for wire drawing, chemical processing, heavy machinery, oil well equipment, etc. It is assembled as a packaged unit with all valves and controls built in, including an auxiliary pump, relief and replenishing valves. Unit maintains any speed from 0 to 1150 rpm, in either direction and has accurate control of creeping speeds under constant load down to 1 rpm.

Equipment shown incorporates special controls for this winch and hoist application. Special controls are available for other applications. Details on request.

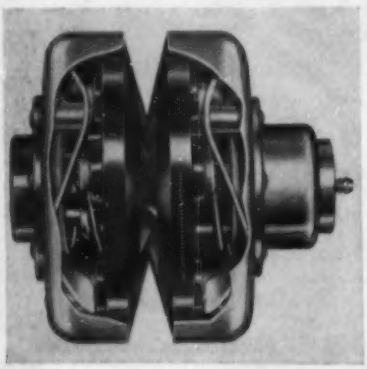
**Waterbury Tool, div of Vickers Inc, Waterbury 20, Connecticut**



### Variable speed drives

**107** • Variable speed reducer is available in 9 sizes ranging from ½ to 10 hp at 1750 input rpm. Power is transmitted from the input shaft through alloy steel driving balls that are in pressure contact with discs attached to the two shafts. Relative speeds of the shafts are adjusted through a 9:1 range by changing angular positioning of the axles on which the balls rotate. This results in an infinitely variable and stepless range of output speeds from one constant speed power source. Complete description and specifications in manufacturer's bulletin K-100, available on request.

**Cleveland Worm and Gear Co, 3249 E 80th St, Cleveland 4, Ohio**



### Variable speed pulleys

**108** • Unit permits infinitely variable speeds from a constant speed motor. By turning a handwheel, motor assembly is moved toward or away from driven pulley, allowing standard V-belt to run over various pitch diameters. Movement toward driven pulley produces maximum speed variation, movement away produces the minimum. Exclusive feature is claimed to be the cam and cam follower assembly on back of pulley faces. This allows pulleys to adjust automatically to maintain given speed with large load variation, while regulating belt tension and maintaining alignment.

**Equipment Engineering Co, 2853 Columbus Ave, Minneapolis 7, Minn.**

### Bench type cut-off machine

**116** • Production cutting of up to 1000 pieces of 1¼ OD pipe per hr is claimed for this bench-type pipe and tube cut-off machine.

Unit cuts from ⅝ to 1¼ OD pipe and tubes, from light to 12-gage wall thicknesses. Drive is by a ¼ hp gear headed motor. Cord connects to 115 v, ac outlet. Tempered cutting wheel is 7-in. diameter.

**Continental Machine Co, 1952 N Maud Ave, Chicago 14, Ill.**

### Two-wire thermocouple

**117** • Two-wire thermocouple, encased in stainless steel tubing, is available with either of two types of terminal heads; an open head assembly or screw-cover head. Accuracy is rated at ±5 F over a range from 0 to 1000 F.

Fiberglass insulation used in the new model permits greater application flexibility than ceramic-insulated pencil-type models, according to manufacturer. Available in 6 to 60-in. lengths. Full details on request.

**Minneapolis-Honeywell Regulator Co, Industrial Div, Wayne & Windrim Ave, Philadelphia 44, Pa.**

### Thread lubricant

**118** • Thread lubricant for use on titanium, stainless steel and aluminum is available in two grades. *Blue Goop* for temperatures to 400 F eliminates galling so threads can be reused. *Silver Goop* for temperatures to 2100 F is an anti-seize compound for use on threaded parts of high temperature alloys.

**Crawford Fitting Co, 884 E 140th St, Cleveland 10, Ohio**

### Die steel alloy

**119** • *Ottawa 60*, specifically developed to deep draw and form stainless steel, is a high carbon, high vanadium alloy. It is produced in bars and forgings for use without galling or pickup. Technical data on request to manufacturer.

**Allegheny Ludlum Steel Corp, 2020 Oliver Bldg, Pittsburgh, Pa.**

For details on these items use post cards p 165. Identify request with item number.

## CHECK THESE TOO . . .


**Gate valve line blind** . . . . . p 170
**Back pressure relief valve** . . . p 170
**Direct-flow pump** . . . . . p 172
**Pumps with mechanical seals** . . p 172
**Exhaust fan set** . . . . . p 174
**Electromagnetic flow meter** . . p 174
**Aluminum alloy cable pulley** . . p 176
**Compact V-12 power unit** . . . . p 176
**Internal tube cutter** . . . . . p 178
**375-amp heavy-duty trolleys** . . p 178

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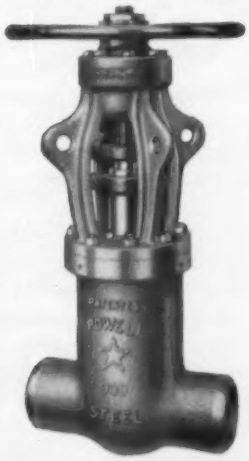
. . . THE COMPLETE QUALITY LINE . . . POWELL VALVES . . . THE COMPLETE QUALITY LINE . . .

# POWELL VALVES FOR POWER PLANTS

FIG. 375—Bronze Gate Valve For 200 Pounds W.S.P

FIG. 1793—Iron Body Bronze Mounted Gate Valve For 125 Pounds W.P.

FIG. 19003—900-Pound Pressure Seal Gate Valve



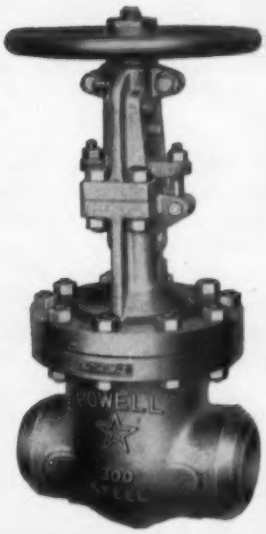


FIG. 3003—Steel Gate Valve For 300 Pounds W.S.P.

POWELL VALVES . . . THE COMPLETE QUALITY LINE . . . POWELL VALVES

Just name the valve you need for your power plant—Powell can supply it. And you can be certain that every Powell Valve will give you *dependable* flow control.

Shown above are just a few Powell Valves for power plants. Investigate the *complete* line of quality valves that have a proven record of long life and dependable service.

Consult your Powell Valve distributor. If none is near you, we'll be pleased to tell you about our complete line, and help solve any flow control problem you may have. Write . . .

**The Wm. Powell Company, Cincinnati 22, Ohio..... 109TH year**

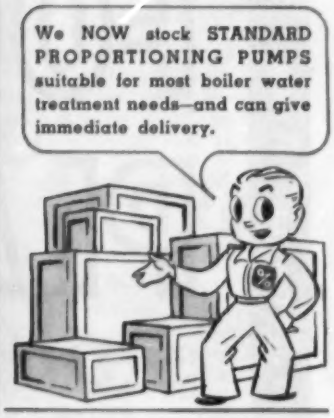
# CHEMICAL PUMPS for *Boiler Water Treatment*

**. . . for the SMALLEST industrial installation**

**to the LARGEST central station**

Simplex Model 1105-S Adjust-O-Feeder for feeds up to 20 GPH and into pressures up to 650 psi.

Battery of 2X Series — High Pressure Adjust-O-Feeders for phosphate treatment


We NOW stock STANDARD PROPORTIONING PUMPS suitable for most boiler water treatment needs—and can give immediate delivery.

All but the smallest Proportioneers chemical pumps are equipped with "fluid sealed" stuffing glands which prevent build-up of chemical incrustation on plungers. All plungers are super-finished to close tolerances for maximum accuracy and long wear. All bearings — for speed reducer, connecting rod, and wrist pin — are of anti-friction type. All moving parts are lubricated by only three pressure lube fittings. All measuring cylinders are removable and can be obtained in Meehanite iron, steel bar stock, or stainless steel. All check valves may be either built-in or removable — and single or double seated as specified.

Other accessories pertinent to boiler water treatment are also supplied, including special dissolving and storage tanks, alarm systems, relief valves, automatic feeding and flushing systems, control panels, and control systems for flow-responsive actuation from new or existing flow meters.

Thousands of Proportioneers metering pumps are daily feeding chemicals to correct boiler water conditions — reducing boiler maintenance, minimizing operator responsibility, and providing positive control of chemical application. Write today for Brochure SM-9020. Proportioneers, Inc., 354 Harris Ave., Providence 1, R. I.

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### AIR CONDITIONING, REFRIGERATION

**1** **Air conditioning** and refrigeration units. Typical installations and general descriptions in illustrated 12-page bulletin 97-E. Frick Co, Waynesboro, Pennsylvania.

**2** **Dust collector.** Dry centrifugal type unit has rating of 333 cfm for each 4-in. diameter tube. Illustrated 4-page bulletin 251. American Air Filter Co, Inc, Louisville 8, Kentucky.

### BOILERS AND AUXILIARIES

**3** **Steam generators,** package water tube *type D* units with capacities from 8000 to 40,000 lbs of steam per hr. Illustrated 8-page bulletin gives dimensions and engr data. Superior Combustion Industries, Inc, 1475 Broadway, New York 36, New York.

**4** **Castable and gunning refractories** for steel mill furnace construction and repair. Illustrated bulletin A-33-54. The Ramtite Co, 1809 S Rockwell St, Chicago 8, Illinois.

**5** **Refractory-fiber felt *Thermoflex*** for service to 2000 F. Advantages, properties, industrial applications in 6-page bulletin. Johns-Manville, 22 E 40th St, New York 16, New York.

### ELECTRICAL CONTROLS

**6** **Motor control centers.** *Concentrol* structures for concentration of a large number of motor controls in one packaged unit. Layout, application data, dimensions, ratings and specs in 8-page bulletin 401. Continental Electric Equipment Co, Box 1055, Cincinnati 1, Ohio.

**7** **Air-break starters** for 2300-5000 v motors. Sectional views, construction and application data in 8-page folder 1060. The Electric Controller & Mfg Co, 2700 E 79th St, Cleveland 4, Ohio.

**8** **Temperature controller** utilizes a thermistor as sensing element. *Series 660* has response differential adjustable down to 0.25 percent of scale (scale range 300 to 600 F). Photos and specs in brochure obtainable from Fenwal Inc, Ashland, Massachusetts.

**9** **Automatic temperature control** for induction heating equipment. Sixteen-page technical bulletin HT-1. Minneapolis-Honeywell Regulator Co, Wayne & Windrim Aves, Philadelphia 44, Pennsylvania.

**10** **Temperature controls** contain two independent electric switches for operation to 1800 F. Operation, construction, specs in 2-page bulletin 108. Burling Instrument Co, 16 River Road, Chatham, New Jersey.

**11** **Selective telemetering** applications for remote control systems. Diagrams and descriptions in 12-page technical bulletin ATIC-939. Motorola Communications & Electronics, Inc, 4501 W Augusta Blvd, Chicago 51, Illinois.

**12** **Voltage stabilizers** to meet power requirements ranging from 5 to 2000 watts. Applications, characteristics, specs in 16-page catalog 4-260. Raytheon Manufacturing Co, Dept 6120-PR, Waltham 54, Massachusetts.

### ELECTRICAL EQUIPMENT

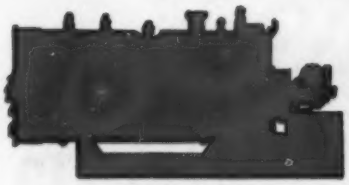
**13** **Power transformers.** Illustrated 14-page manual provides detailed physical and electrical characteristics for liquid-filled, single and three phase units from 750 through 10,000 kva. Bulletin 133, R E Uptegraff Manufacturing Co, Scottdale, Pennsylvania.

★ **Rubber insulated cable** up to 5000 volts. Capacity tables, short circuit curves, voltage regulation formulas, pulling tension and bending radii, methods for determining conduit sizes, in 128-page technical catalog 1085. ★Request direct on company letterhead from The Okonite Company, Passaic, New Jersey.

**14** **Bus ducts.** Plug-type units in 10-ft lengths can be connected from either side. Applications, dimensions, specs in illustrated 24-page bulletin 300. Continental Electric Equipment Co, Box 1055, Cincinnati 1, Ohio.

(Continued on page 208)

# HOW SUPERIOR SOLVES YOUR STEAM PROBLEMS



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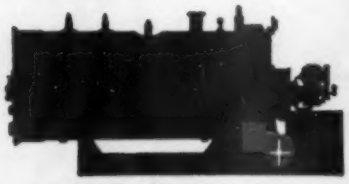
Completely factory-assembled and tested, a Superior Steam Generator is backed by undivided responsibility.



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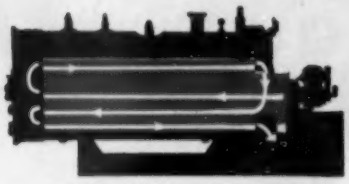
... eliminates need of an expensive chimney ... Multiple fans draw evenly on all tubes, reducing maintenance.

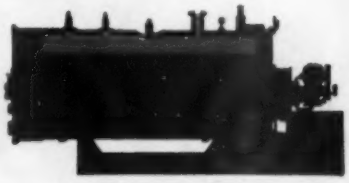


***4-PASS, DOWN-DRAFT DESIGN***

High gas velocities produce high efficiency. Down-draft design promotes rapid evaporation, quicker steaming.

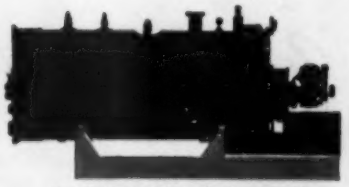
***AMPLE HEATING SURFACE***

A minimum of 5 sq. ft. of heating surface per boiler horsepower assures maximum efficiency at full rated capacity.



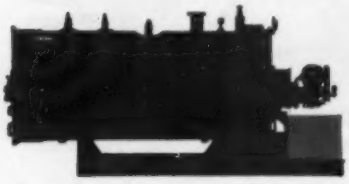
***RESERVE CAPACITY***

Greater steam space and large evaporating surface provide ample reserve capacity & better than 99% dry steam.



***NO EXPENSIVE FOUNDATION***

Built on a rigid channel iron base, a Superior Steam Generator needs only a floor capable of supporting its weight.



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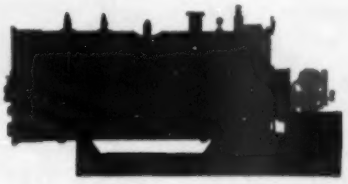
All controls essential to completely automatic operation are factory-wired into an easily accessible control panel.



***BURN OIL, GAS, OR BOTH***

Superior Burners burn oil or gas or a combination of both ... changing from one fuel to the other in seconds.

Superior Steam Generators are the ideal choice for a new steam plant ... the simplest answer to expanding your present plant ... the easiest solution to replacing obsolete boilers.

Guaranteed to develop maximum rated capacities at thermal efficiencies in excess of 80%, their design embodies features which insure long-lived dependability and maximum fuel economy.

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**SUPERIOR**
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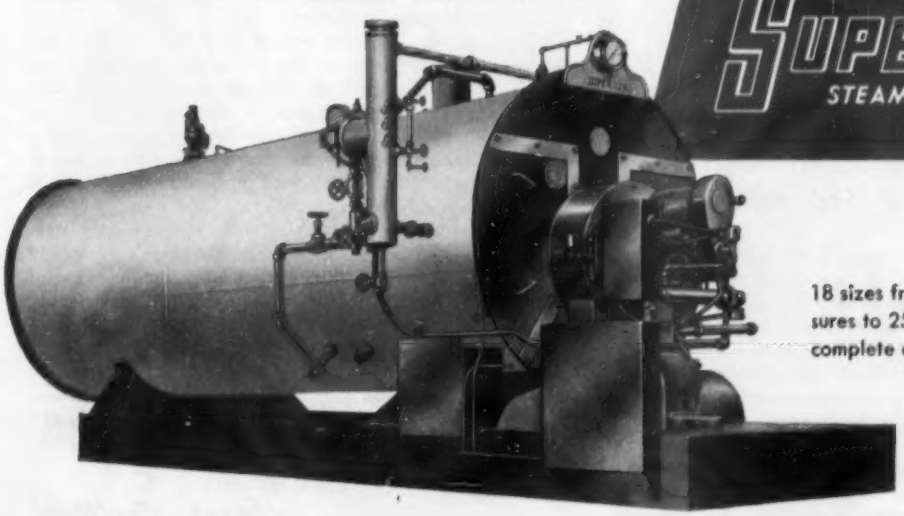


18 sizes from 20 to 600 b.h.p. for pressures to 250 p.s.i. or for hot water. For complete details write for Catalog 700.

**SUPERIOR COMBUSTION INDUSTRIES INC.** TIMES TOWER, TIMES SQUARE, NEW YORK 36, N.Y.

# George Edwards' Scrapbook

## Another idea on retiring

Dear George: Your remarks in September POWER about retiring hit a vital spot with many of your engineer friends. I'm nearly 67. Those of us who have been preparing for retirement need not worry. But the majority have a retirement problem.

You can do younger men a great service by calling attention to the need for making plans *early*. I started late, at 45. I began making investments, which grew into enough to retire on. Of course, my wonderful wife gets the credit. We wanted to travel, to see this great country at a slow pace, also to study and relax.

We sold our old homestead and bought a mobile 35-ft "royal land yacht." Now we are good for five years of travel and study—within our retirement income.

After that, I will be under a palm tree, manufacturing a gadget to keep busy without having to show up for work at eight o'clock. My wife says she is also retiring, so I'll take up cooking, laundering, sewing and housekeeping to do my share in this business of living. The wife says that with my "line" and experience I can write. I knocked about for 50 years, operating and building power plants.

During that time I wrote short articles for engineering magazines, just enough to pay for my subscriptions and for engineering books. I salute these magazines, especially POWER, the greatest educator in the power field.

*This letter is from Bill Pender, New Orleans, La.—GE*

## Watch those promises

Make promises sparingly and keep them faithfully, no matter what it costs you.

## Grease monkeys are expensive

Any old grease monkey was turned loose on maintenance in the good old days. But today, even grease monkeys cost money—and unless they know what they are doing damages will cost far more than their wages. All of this adds up to one thing: maintenance is *big* business.

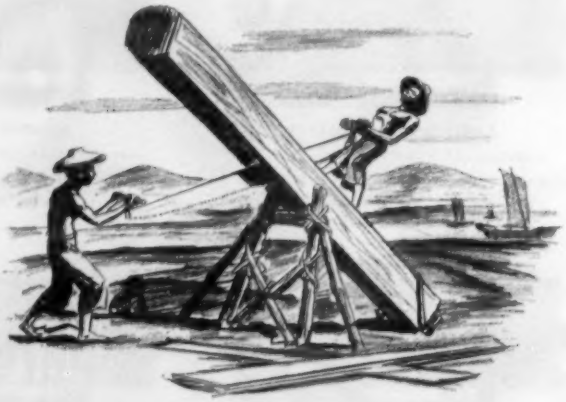
Today a firm like Anderson-Nichols of Boston will step into your plant and propose a sound engineering approach to maintenance in these eight basic areas: organization, personnel, facilities, methods, planning—scheduling, paper work, records—controls, reports to management and on policy.

I'm glad to know maintenance consultants are coming into their own. They'll save industry plenty of money.

## Free consulting service

A sales-engineer friend told me one large sugar refinery never let's him get past the front office. He is the top engineer for his firm and has solved many ticklish problems for leading plants around the country. Some firms not only invite him into their plant, but they round up all department heads so each can ask questions and cash in on his experience.

Too bad management of some companies doesn't realize the great amount of good a sales engineer can do them. The engineer locked up with his headaches can learn much from salesmen who get around. Such a person does not waste your time. Talking to him is like having a consultant —who doesn't send you a bill. You only pay for his product—if you use it.



## Don't saw out boards by hand

American industry invests $11,000 for tools and supplies for each employe. That's why we out-produce other nations.

A friend told me that the first time he sailed up the Yangtze River in China, his ship passed a local sawmill. Two Chinese were sawing an immense log into boards—by hand. One stood on top of the inclined log and the other underneath, each tugging away at the saw. Only investment there was one hand saw.

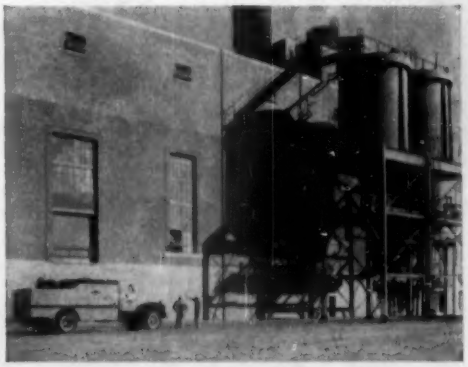
Five days later his ship passed the same saw mill and the two men were busy on the same log, although a few boards had been sawed off. By contrast, when his ship pulled into a large lumber mill in Washington, he saw a gang of saws rip through an immense log in less than a minute. And the log was not touched by human hands. One operator did everything with pushbuttons. Investment was in tens of thousands of dollars.

There was a time when handwork was the only way. But gradually industry learned that machines cost less in the long run—and freed high-priced labor for more useful things. Yet we still do many things by hand that we could do by machines.

Let's look around our plant and see how many labor-saving devices we can use. If we don't, our competitors will get the jump and give our firm a run for business—and win. Isn't it time to *stop* sawing out boards by hand?

George Edwards

# 300,000 PPH BOILER CLEANED CHEMICALLY IN ONE DAY!



Dowell engineers bring solvents to the job in truck-mounted tanks, along with all pumping and control equipment. They apply the chemicals as necessary—by filling, spraying, jetting, cascading or vaporizing.

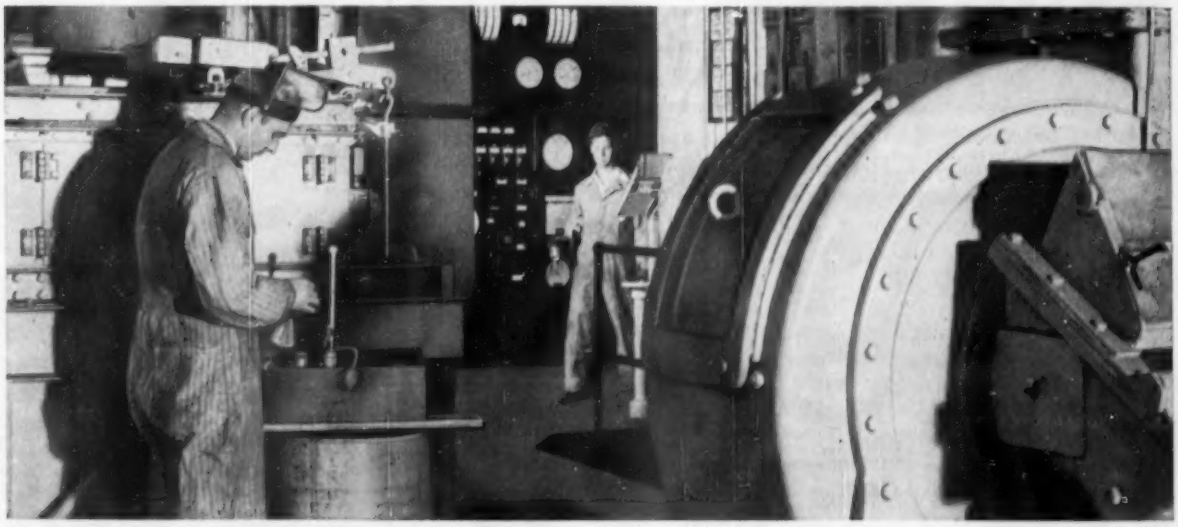
## Comparative cases showed DOWELL cleaning took less time . . . removed more scale than mechanical methods

This is a case history on a 300,000 pound per hour boiler in a refinery. A routine inspection showed that iron oxide and silicate scale fouled the tubes. Dowell engineers cleaned the boiler with chemical solvents in less than 22 hours.

Dowell chemical cleaning is the standard method of removing deposits from boilers in this plant. Comparative tests showed that the chemical method was both faster and more thorough than the mechanical means previously used. The operator was surprised at the relatively large amounts of scale and sludge removed by chemical cleaning. Dowell has cleaned 25 of the 27 boilers in this plant. Several have been cleaned as many as three times on an annual basis.

Dowell liquid solvents go wherever steam and water flow, reaching surfaces inaccessible to other methods. No special scaffolding is required. *Dismantling and down-time are kept to a minimum.* Often, equipment may be cleaned while in operation.

Perhaps chemical cleaning could improve the efficiency of equipment in your plant—for example, heat exchangers, piping systems, tanks and process towers. For complete information and estimates, call the nearest of more than 130 Dowell offices, or write directly to Dept. A-23, DOWELL INCORPORATED, TULSA 1, OKLAHOMA.



***DOWELL SERVICE***

*chemical cleaning service for industry*

DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

# LATTICE BRAID* Packing

## helps protect valuable plants at The New York Botanical Garden

*Registered Trademark. Only Garlock makes LATTICE BRAID rod and shaft packings.

Continuous steam heat service is essential during the winter months at The New York Botanical Garden. Any breakdown could cause the loss of many valuable plants. That's why R. E. Wills, Chief Engineer at the Botanical Garden is now using LATTICE BRAID Packing on all expansion joints handling the steam. On this service LATTICE BRAID lasts *two to three years* with no leaks or breakdown. *And* it remains soft and pliable at all times. The best service from previous packings was six to twelve *months*.

Put Garlock LATTICE BRAID Packing to work for your company. All the braided strands of this unique packing are lattice linked together into one structural unit. The strands hold together even when the packing is worn far beyond the limits of wear of ordinary braided packings.

LATTICE BRAID is made from flax, cotton, asbestos, wire-inserted asbestos, Teflon, and asbestos with Teflon impregnation—for various types of services.

*Get all the facts about* LATTICE BRAID *Packings. Contact your Garlock representative or write for new folder AD-131.*

**THE GARLOCK PACKING COMPANY, PALMYRA, NEW YORK**

**Sales Offices and Warehouses:** Baltimore • Birmingham • Boston • Buffalo • Chicago • Cincinnati • Cleveland Denver • Detroit • Houston • Los Angeles • New Orleans • New York City • Palmyra (N. Y.) • Philadelphia Pittsburgh • Portland (Oregon) • Salt Lake City • San Francisco • St. Louis • Seattle • Spokane • Tulsa.

**In Canada:** The Garlock Packing Company of Canada Ltd., Toronto, Ont.

GARLOCK LATTICE BRAID PACKING

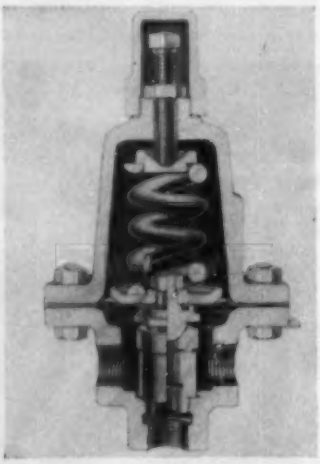

## More EQUIPMENT NEWS

Begins on page 156

### Gate valve line blind

**134** • Unit has no bolts and requires no lifting of plates on part of the operator. Operating on the gate valve principle, the rising stem raises blind plate from valve body into line with a machined carrier track incorporated in top of valve yoke. Here the blind plate slides off stem onto carrier track, and the other blind or spectacle plate is slid onto valve stem and lowered into position. Full details on request. **Vernon Tool Co, Ltd, 1101 Meridian Ave, Alhambra, California**

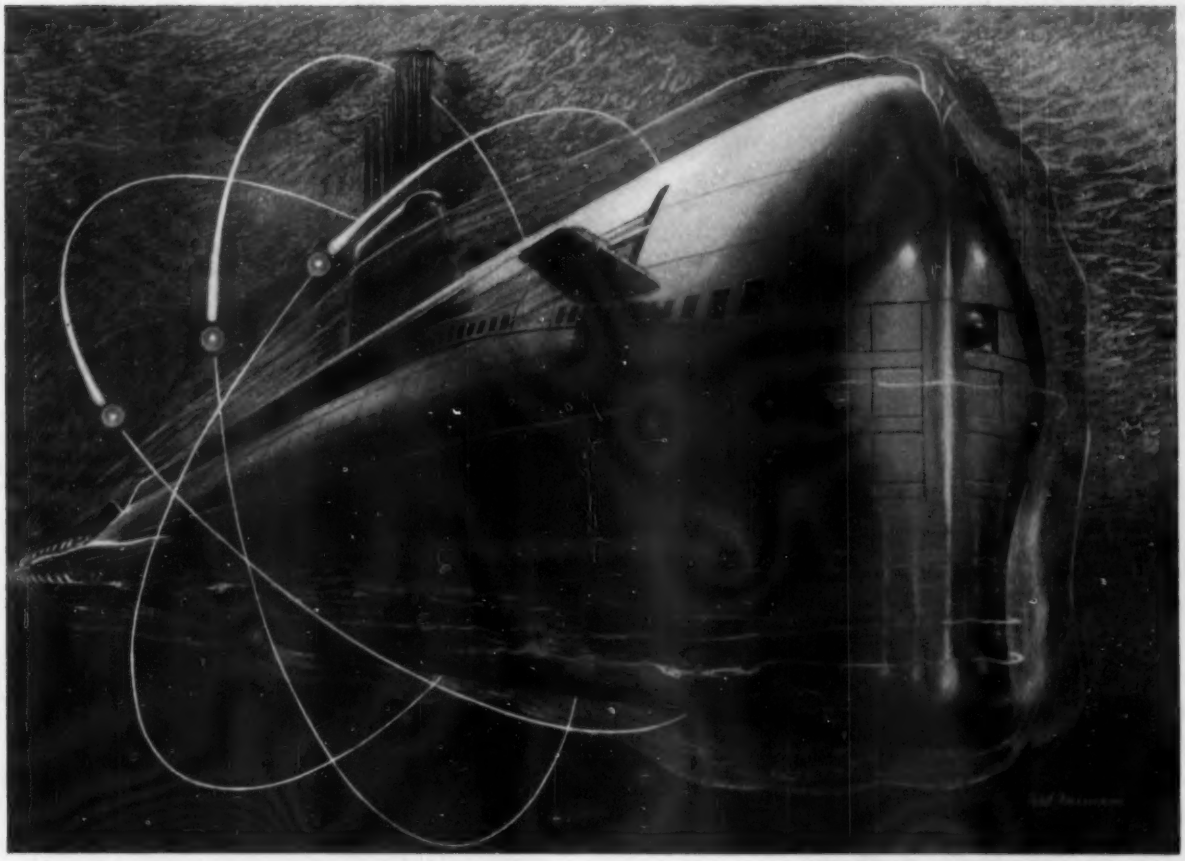
For more data on these items, use post cards p 165. Identify your request with item number



### Back pressure relief valves

**129** • Back pressure relief valves, designed for pressures to 400 psi, are available in pipe sizes from ½ to 2-in. Units automatically maintain predetermined pressure on inlet side by relieving into a low pressure line, and are claimed to be substantially unaffected by pressure variations on the discharge side.

Outstanding feature, according to manufacturer, is floating ring principle with spherical seat disc that promotes unusual



# THE "NAUTILUS"

## Atomic Sub and Builders Rely on World's Greatest Lubrication Knowledge

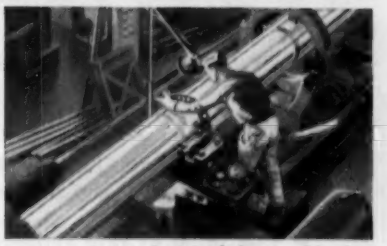
With the launching of the "Nautilus"—world's first atomic-powered submarine—the U.S. Navy crossed the threshold of the atomic age.

Socony-Vacuum is proud that it has been able to play a dual role in this most significant event.

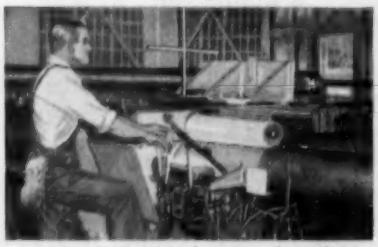
First, famous Socony-Vacuum lubricants are now protecting vital machinery aboard the "Nautilus."

Second, Electric Boat Division, General Dynamics Corp.—builder of the "Nautilus"—relies 100% on our lubricants and a program of Correct Lubrication to protect its plant equipment... has done so for the past 34 years!

We wish the "Nautilus" and her crew all success... pledge our continued cooperation, in every way possible, to the Navy and its suppliers, toward the end of keeping America and her allies strong.



**A snorkel intake tube** being machined to very precise tolerances on one of the large lathes in the Groton plant.



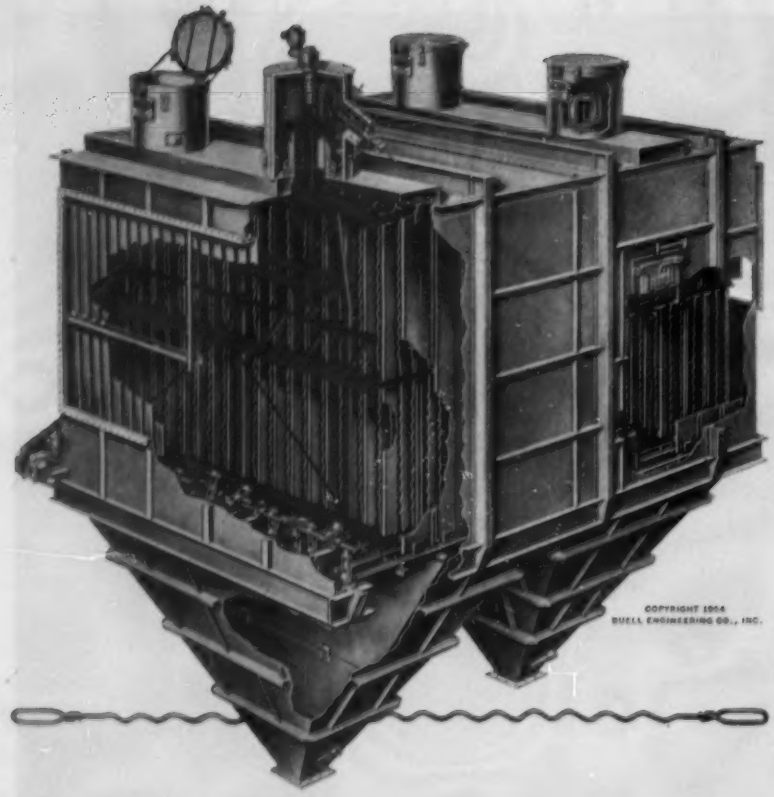
**Hydraulic bender** shapes section of 8-in. steel pipe in two minutes. This operation formerly took a full day.

**SOCONY-VACUUM** *Correct Lubrication*

***FIRST STEP IN CUTTING COSTS***

SOCONY-VACUUM OIL CO., INC., and Affiliates: MAGNOLIA PETROLEUM CO., GENERAL PETROLEUM CORP.

SOCONY-VACUUM




# World's Most Effective Dust Collector

Already you have heard about the amazingly high efficiency and low maintenance of Buell "SF" Electric Precipitators. Now... we'd like to tell you about the Buell *exclusives* that make these money-saving advantages possible!

**Spiralectrodes** permit higher emission than any other electrode . . . result in unequalled efficiency in dust collection.

**Continuous Cycle Rapping** eliminates "puffing," keeps electrodes constantly clean, prevents re-entrained dust.

**Positive Flow Control** by specially designed baffles prevents channeling, scouring and harmful eddies.

**Sectionalized Design** keeps maintenance extra simple . . . eliminates need for complete shutdown.

Write today for a free brochure which describes *all three* of Buell's proven systems—The Collection and Recovery of Industrial Dust. Dept. 50-A, Buell Enginering Company, 70 Pine Street, New York 5, N. Y.

buell

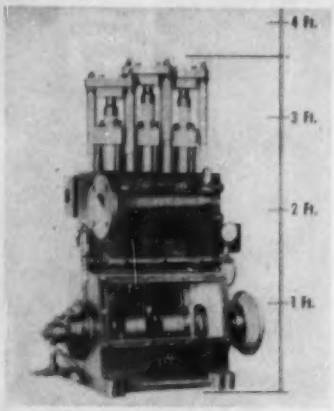
MECHANICAL ELECTRICAL *20 Years of Engineered Efficiency in* DUST COLLECTION SYSTEMS

# More EQUIPMENT NEWS

Begins on page 156

sensitivity, good closure, large capacity and practically frictionless performance. Unit has three connections—two side inlet connections and one bottom discharge connection. It may be installed in straight-through fashion or as an angle-type with one side connection plugged. Bulletin FR-1,2.

**A W Cash Valve Manufacturing Corp, 666 E Wabash Ave, Decatur 60, Ill.**



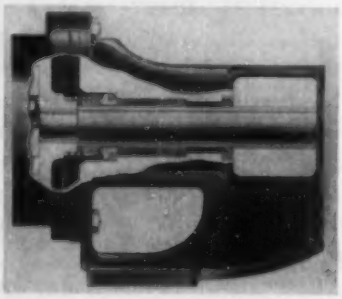

## Direct-flow pump

**130** • *Powr-pac* direct-flow pump is available in plunger diameters from 2½ to 11/32 in. for pressures from 390 to 20,700 psi, with displacement from 109.6 gpm to 2.08 gpm. Because of its smaller size, manufacturer states, it offers economies to users who previously have been forced to buy pumps larger than actually needed.

Feature of the 2½-in. stroke, 25-hp unit is sectionalized fluid-end design. Individual fluid-end sections may be replaced at considerable less cost than entire fluid-ends. Pump lubricant is force fed from a crankshaft-driven lube oil pump. Main bearings are splash lubricated and a lube oil failure cut-out switch is standard equipment. Further details in data sheet 63.

**The Aldrich Pump Company, Allentown, Pennsylvania**

For more data on these items, use post cards p 165. Identify your request with item number



## Pumps with mechanical seals

**146** • Heavy-duty pumps are available with mechanical seals in a full size range from 10 to 300 gpm capacities. They are suitable for pressures to 200 psi on lubricating liquids and to 100 psi on non-lubricating liquids. Seals are available on unmounted pumps and mounted units with gear, V-belt,

# Super Tough

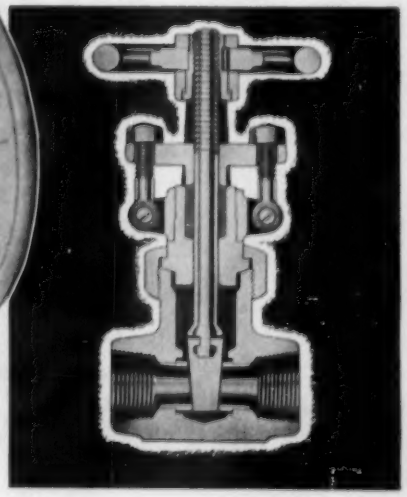
## Chapman List 960

### Small Forged Steel Gate Valve

Super means "way beyond the ordinary" and that's just what this rugged gate valve is . . . it's tough enough to lick *any* gate valve problem in its range . . . dependable enough to keep maintenance costs down under the most severe conditions. That's why List 960 is specified for more different applications than any other valve of its kind.

Chapman List 960 is tough because . . . wedge faces are hardened to 800 Brinell, so they won't seize or gall . . . seat rings are hardened stainless steel, so closure is always tight and operation is always smooth, without excessive wear . . . stem-and-gate connection is extra-husky to stand up under even unusual stresses.

Specify Chapman List 960 for every use you have for small forged steel gate valves. In sizes from ¼" to 2". Rising stem with yoke (shown) or rising stem with inside screw. Bonnet joint is either metal to metal or gasketed, depending upon application. Pressure range is from 380 pounds at 1000°F to 2000 pounds at 100°F. For higher ratings, specify List 990. Write today for your copy of Catalog 10.



**The CHAPMAN Valve Manufacturing Co.**
INDIAN ORCHARD, MASSACHUSETTS

Yes, Dart Unions fit tighter and last longer because their two bronze seats are precision ground to a true ball joint. You get a drop-tight connection without straining arm, wrench or union. What's more, a Dart uncouples just as easily. Ask your supplier.

*QUICK FACTS*

- Extra wide bronze seats resist pitting and corrosion.
- Nut and body of air-refined, high test malleable iron are practically unbreakable
- Heavy shoulders can withstand the toughest wrench abuse
- Each Dart is individually vacuum-tested

**DART UNION COMPANY**
**Providence 5, Rhode Island**
*The Fairbanks Co. Distributors*
Boston • New York • Pittsburgh • Rome, Ga.

**DART UNIONS**


# More EQUIPMENT NEWS

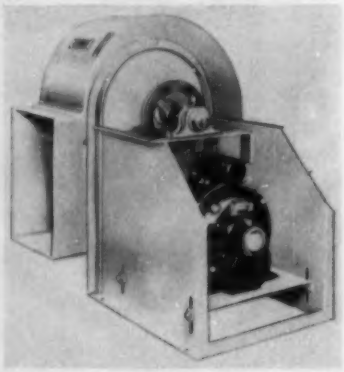
Begins on page 156

direct, double gear, or V-belt and gear drives. Chief advantages of mechanical seals, according to manufacturer, are leakless operation, elimination of need to pack pumps, and carbon graphite bushings that require no external lubrication.

The seal is constructed of all iron and steel with *Buna N* synthetic rubber parts for use on standard-fitted, all iron, steel-fitted and bronze-fitted pumps. For all bronze pumps, the mechanical seal is of bronze, stainless steel and ni-resist construction, with *Buna N* synthetic rubber parts.

Normal-duty pumps with mechanical seals are also available for pressures to 100 psi on lubricating liquids and 50 psi on non-lubricating liquids. Details in bulletin SP-336 (normal duty) and SP-344 (heavy duty).

**Viking Pump Co, Cedar Falls, Iowa**

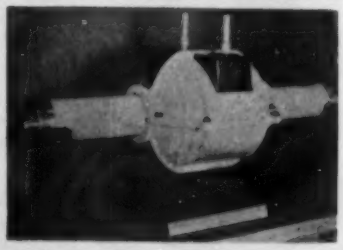


### Exhaust fan set

**150** • Self-contained coated exhaust fan set is designed for services ranging from simple ventilating to handling of moderately corrosive atmospheres. Units are supplied with baked phenolic, vinyl or latex coating to resist a wide range of chemicals including organic materials. Unit capacities range from 300 to 700 cfm.

**Heil Process Equipment Corp, 12901 Elmwood Ave, Cleveland, Ohio**

For more data on these items, use post cards p 165. Identify your request with item number.



### Electromagnetic flow meter

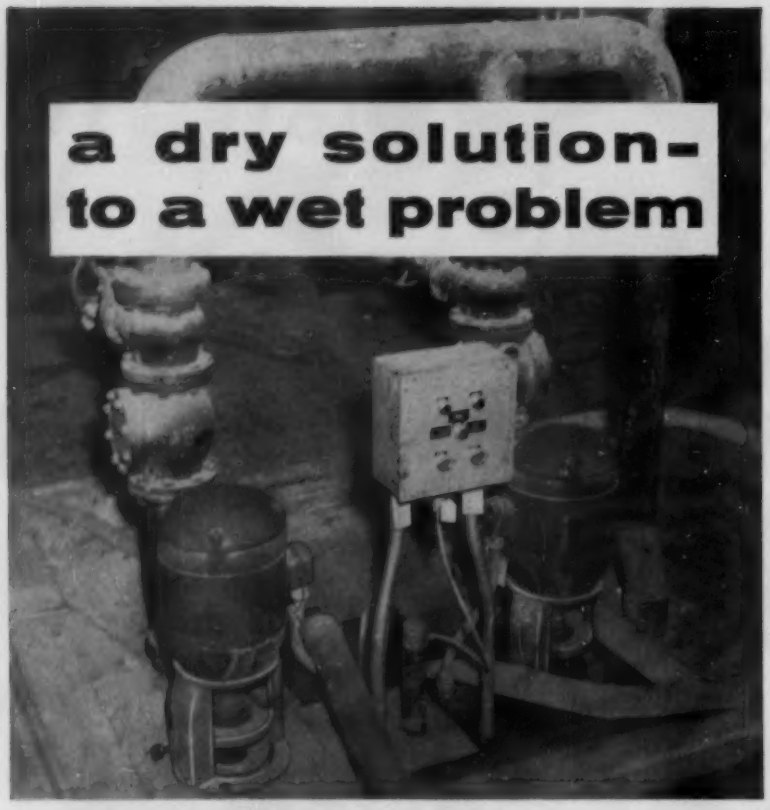
**151** • Unit, designed for 2 to 8 in. flow lines, measures volume flow rate of any liquid of sufficient conductance and velocity. Unaffected by pressure, viscosity, density or changes in conductivity of the flowing liquid, it is recommended for aqueous solutions, acids and other corrosives.

Unit consists of nonmagnetic flow tube

**Heat Recovery is Dollar Recovery.** Whether you use it to generate steam . . . or dissipate it up the stack — every BTU you generate costs you money. That's why, even on boilers with capacities as low as 25,000 pounds of steam per hour, it is most often economically right to do something about the waste heat. With the new *Packaged Ljungstrom Air Preheater*, you can apply to your small boilers the principles of heat recovery used by large utilities, where fuel efficiency is sought in every way possible. The Packaged Ljungstrom Air Preheater is a *continuous regenerative counterflow* unit. That is it transfers heat continuously from exit gas to incoming air streams by exposing heating surfaces on a slowly revolving rotor, alternately to both streams. It is highly efficient . . . low in cost . . . and fully reliable.

*For more complete information, write today to The Air Preheater Corporation*

**The Air Preheater Corporation**

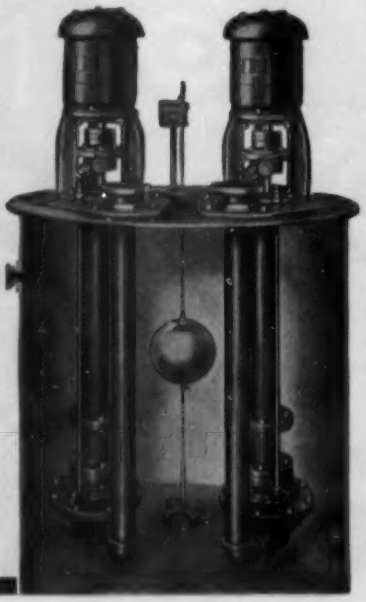



A large-volume user of water had a "wet plant problem." The solution is pictured above. Here you see two Deming Vertical Sump Pumps each with a 10 HP motor. Each pump has a rated capacity of 500 GPM with a 50-foot head. Unwanted water from all areas of the plant drains into a pit. When water in the pit rises to a predetermined level, one of the Deming Sump Pumps goes into action automatically. Or, if required, both pumps can be used simultaneously. If you have a "wet plant problem" there's a Deming Distributor near you to help you solve it.

## DUPLEX UNITS

Where conditions require two pumps to operate separately, in sequence, or simultaneously, Deming Vertical Sump Pumps can be furnished as Duplex Units. The complete line includes a wide range of single and duplex units to meet most sump pump requirements. Write for illustrated BULLETIN 4600-A.

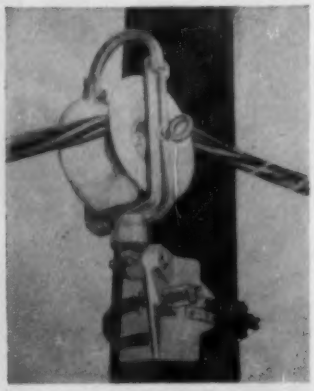
**THE DEMING COMPANY**
547 BROADWAY • SALEM, OHIO




# More EQUIPMENT NEWS

Begins on page 156

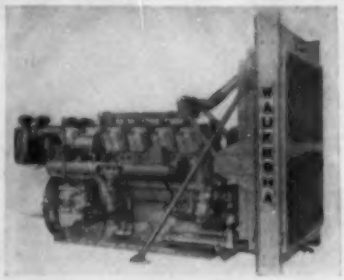
by an ac electromagnet. When conductive liquid passes through tube, an alternating voltage is set up between electrodes that varies linearly in proportion to rate of flow. Lead wires from electrodes transmit this voltage output to an electronic recorder, producing a chart record in appropriate units of flow. Request form TI 27-A-71a.
**Foxboro Co, Foxboro, Mass.**



### Aluminum alloy cable pulley

**131** • Aluminum alloy pulley is claimed to reduce installation time of aerial cable by as much as 75%. Weighing less than 25 lbs, unit is designed for cable loads to 600 lbs. It requires only 8 in. of pole length and may be mounted on the pole cable for cable attachments to the crossarm. Fingertip snap latch on safety bar permits pulley release after cable has been attached. Pulleys of greater load capacity will be supplied on request.
**Tey Manufacturing Corporation, Milford, Connecticut**

For more data on these items, use post cards p 165. Identify your request with item number



### Compact V-12 power unit

**127** • Twelve-cylinder power unit is available for use with propane-butane or natural gas fuel, and as a full diesel with normal aspiration or turbo-supercharged. High compression, overhead valve, four-cycle engine has 8½-in. bore and stroke and 5788 cu in. displacement. Operating on butane-propane it develops approximately 870 hp with radiator, fan and air cleaners. Unit rating of the normal diesel and turbo-charged diesel are approximately 800 and 1100 hp, respectively. Bare engine ratings are higher. Maximum speed is 1200 rpm. Applications include heavy compressor operations, municipal power plants, central

# INSULATED METAL WALLS

**for POWER and STEAM GENERATING PLANTS**

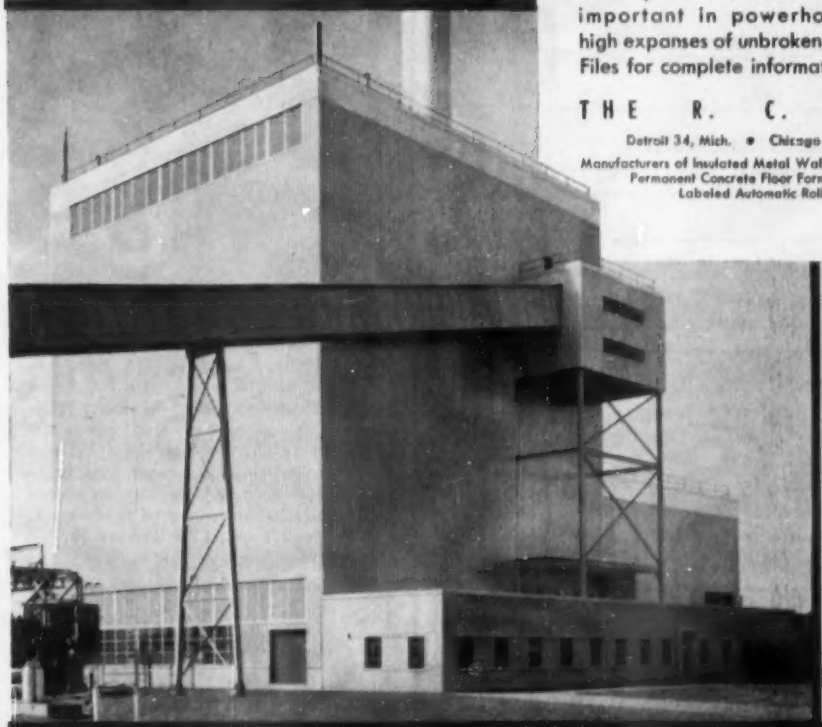
**ALUMINUM, STAINLESS or GALVANIZED STEEL**

Designers of modern power plants are today fully cognizant of the low-cost advantages of light weight metal curtain wall construction . . . new powerhouses with bright aluminum or stainless steel exterior surfaces are appearing all over the country. In recent years, thirty-six modern power and steam generating plants have been constructed with Mahon Insulated Metal Walls. In this type of construction, important building economies are realized through lower material cost, lower labor cost, and the cumulative advantages deriving from reduced construction time . . . buildings can be quickly enclosed with Mahon Insulated Metal Walls—even under low temperature conditions which would preclude masonry construction. Mahon Insulated Metal Walls are available in three exterior patterns in Stainless Steel, Aluminum, Galvanized Steel, or Enamel Coated Steel. Mahon "Fluted" and "Ribbed" walls can be field-constructed up to sixty feet in height without a horizontal joint—a feature of the Mahon wall which is extremely important in powerhouses or other buildings where high expanses of unbroken wall surface are common. See Sweet's Files for complete information, or write for Catalog No. B-55-B.

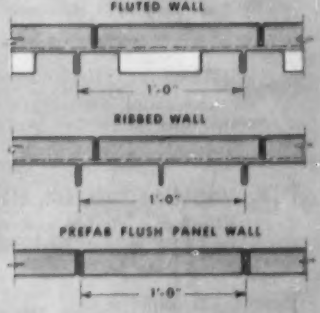
**THE R. C. MAHON COMPANY**

Detroit 34, Mich. • Chicago 4, Ill. • Representatives in All Principal Cities

Manufacturers of Insulated Metal Walls and Wall Panels; Steel Deck for Roofs, Partitions and Permanent Concrete Floor Forms; Rolling Steel Doors, Grilles and Underwriters' Labeled Automatic Rolling Steel Fire Doors and Fire Shutters.



**THREE EXTERIOR PATTERNS**




The Over-all "U" Factor of the various Types of Mahon Insulated Metal Walls is Equivalent to or Better than a Conventional sixteen inch Masonry Wall.

# MAHON

## Choose WESTERN
## for Chemical Treatment of Water, Steam and Fuel

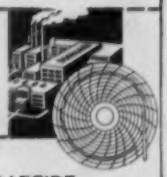
Look them over! Check your needs! Every Western product for treatment of water, steam or fuel is proved in use, technically formulated for each individual problem.

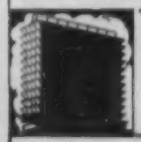
**1** *Steam* + CORAVOL® = *Protection* (FROM CORROSION)

CORAVOL circulating throughout your steam system protects it from corrosive attack; cleans out rust deposits; increases heating and operating efficiency; reduces maintenance and labor costs. CORAVOL is the *original amine process* developed by Western Chemical Company.

**2** WESTERN BOILER FEED WATER TREATMENT

Special formulas for each individual boiler water and operating condition to eliminate scale, corrosion and foaming.





**3** COOLING WATER TREATMENT AND ALGAECIDE

Prevents scale deposit, corrosion, and algae growth in every type of cooling and condenser water system.

**4** BRINE AND SWEET WATER TREATMENT

Prevents corrosion and protects tanks and equipment in refrigerating brine and sweet water systems.

**5** WESTO HOT WATER TREATMENT

Stops corrosion and scaling in hot water supply tanks and lines, maintaining service without impairing potability.

**6** WESTERN LIGHTNING TREATMENT

Disintegrates and removes scale quickly from water jackets, cylinder heads, condensers, compressors, lines, coils, pumps.

**7** WESTERN ALUMINA NO. 45

Provides efficient coagulation in raw water ice manufacture, lime and soda softeners, water supply clarification.

**8** WESTERN SOOT REMOVER

Removes and prevents soot deposits in combustion areas, thus increasing fuel economy and boiler capacity.

**9** WESTERN FUEL OIL SLUDGE DISPERSANT

Eliminates sludge and moisture in fuel oil, effecting clean tanks, lines, and burners, and improved combustion.

Chemical Treatment for Water Steam and Fuel

**WESTERN CHEMICAL COMPANY**

713 Washington Street
Kansas City 5, Missouri

MAIL THIS COUPON TODAY

Western Chemical Company
713 Washington Street
Kansas City 5, Missouri

Send me full information about products checked.

[1] [2] [3] [4] [5] [6] [7] [8] [9]

Name _____

Firm _____

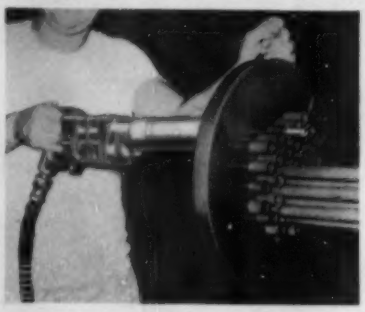
Address _____

City _____ Zone _____ State _____


# More EQUIPMENT NEWS

Begins on page 156

generating plants, shipping, construction and wherever there is need for continuous, heavy-duty operation requiring up to 1000 hp. Complete information on request. **Waukesha Motor Co, Waukesha, Wis.**



### Internal tube cutter

**152** • Lightweight unit is designed to remove damaged or leaky tubes from condensers and heat exchangers. Cutter quickly cuts tube behind the tube sheet. Self-centering unit has two cutters powered by air-driven motor to cut steel and non-ferrous condenser tubes from ⅝ to 1-in. OD. Also cuts tube sheets 1 to 4-in. thick.

**The Airetool Mfg Company, 304 S Center St, Springfield, Ohio**

For more data on these items, use post cards p 165. Identify your request with item number.

### 375-amp heavy-duty trolleys

**153** • Trolleys rated at 375 amp, two and three pole, with speeds to 300 ft per min facilitate movement of heavy electrical equipment having motor loads to 200 hp at 440 v, ac. Factory assembled and ready for immediate use, units have built-in mechanical polarizing stop to insure proper polarity when inserted in the track.

**Feedrail Corp, 125 Barclay St, New York 7, New York**

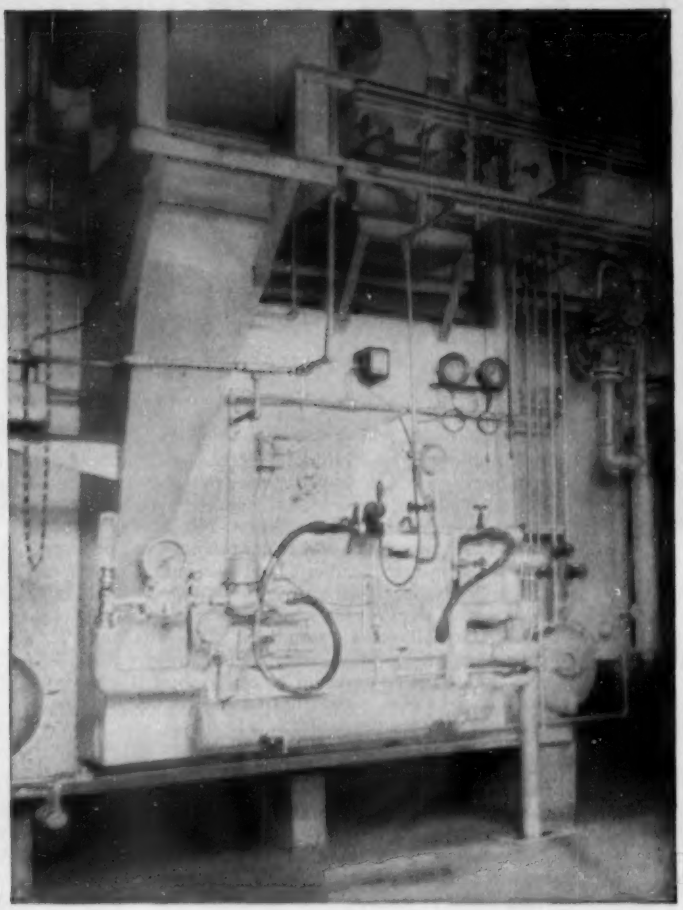
## Modernization Awards

To learn how you can win recognition for your accomplishments, see pp 80-81.

# These three fine H. J. Heinz products produced in plant equipped with WICKES BOILERS

Located in the rich truck farming area of Southern New Jersey, the Salem plant of the H. J. Heinz Company, famed makers of "57 Varieties", specializes in the production of quality Ketchup, Chili Sauce and Tomato Soup. The plant has a capacity in excess of 1,000 tons of tomatoes a day and two newly installed Wickes A-Type shop-assembled Steam Generators are helping to meet high daily production schedules. Each of these oil-fired units has 4,000 sq. ft. of heating surface and a design pressure of 250 psi. Like so many other companies that rely on steam for heat, power and processing, the H. J. Heinz Company knows that Wickes Boilers are a reliable source of low cost steam.

Wickes will design and build water-tube steam generators for any practical size and pressure. Wickes also offers a wide choice of auxiliary equipment so that you can get not only the best steam generator, but also the best correlated equipment. Consult your nearest Wickes representative or write us today.



158

# THE WICKES BOILER CO.

**DIVISION OF THE WICKES CORPORATION • SAGINAW, MICHIGAN**

***RECOGNIZED QUALITY SINCE 1854*** **• SALES OFFICES:** Albuquerque, N. M. • Boston • Buffalo • Charlotte, N. C. • Chicago • Cleveland • Dallas • Denver • Detroit • Fort Wayne, Ind. • Houston • Indianapolis • Los Angeles • Memphis • Milwaukee • New York City • Portland, Ore. • Saginaw • Salt Lake City • San Francisco • Springfield, Ill. • Tampa, Fla. • Tulsa • Washington, D. C.

WHEN YOU PLAN...
TO SAVE COSTS
Factory-trained Cyclotherm engineers will . . . without charge . . . work from drafting board to installation to estimate your steam demands.
TO SAVE TIME
Factory-trained Cyclotherm servicemen are as close as your telephone . . . They are on call at any hour of the day, night or week-ends.
TO SAVE SPACE
Cyclotherm Steam Generators range from 18 to 500 hp. . . . from 15 to 200 psi. For industrial and commercial plants, shipping, institutions.
Select a
CYCLOTHERM
STEAM
GENERATOR

Planning a new building? Remodeling an existing structure? As much as ⅓ smaller than other packaged units, the Cyclotherm Steam Generator allows more space for storage and production. Needs only a minimum-sized, minimum-cost boiler room. Or can be placed in a working area. Radiant heat loss is at a minimum.

Lighter-weight, it costs less to transport. Simpler in design, it requires less rigging time . . . rigging costs.

Yet it delivers a guaranteed 80% efficiency . . . pays for itself in a few years in fuel savings alone . . . cuts maintenance costs up to 50%. And it gives you 66% more steam generating power per sq. ft.! Needs less heating area per boiler h.p.!

Exclusive, patented Cyclonic Combustion combined with simplicity of boiler design produces maximum heat transfer wringing every degree of heat from each fuel molecule . . . wasting none. Does in 2 passes what other combustion methods accomplish in 4. Cyclotherm's even rate of heat transfer eliminates localized, heat-retarding scale and "hot spots." All these features assure you of maximum performance.

***FREE*** **Discover how Cyclotherm can give you more steam for your dollar. RETURN THIS COUPON TODAY.**

YEARS AHEAD IN STEAM GENERATION
CYCLOTHERM®
Steam & Hot Water Generators

Cyclotherm Division
U. S. Radiator Corp.
Oswego, New York

Cyclotherm Division, U.S. Radiator Corp.
Dept. 424 Oswego, N. Y.
Gentlemen: I am interested in reducing steam costs and space.
☐ Please send a Cyclotherm engineer to help estimate my steam requirements.
☐ Please send me your illustrated folder on Cyclotherm Steam Generators.
NAME_____
COMPANY_____
ADDRESS_____
CITY_____ ZONE___ STATE____


# MARMADUKE

Continued from page 144

tried to impress me with a lot of fancy words he figured would snow me under. Then his plan was to take me for a canoe ride over Niagara Falls.

"'My name's Michael Worthington Poey,' he drooled, twirling his waxed mustache. 'I'm president of the Poey Magic Insulation Co of New Orleans. I understand you have a lot of hot lines to cover here.'

"'Yup,' I said, 'there's 25 miles of lines that's insulated—or should be.' That information was like pouring oil on fire—he really revvied up.

"'I know a high-caliber engineer like you'll be interested in the latest development in pipe insulation,' he started. 'After years of scientific experimenting, I finally came up with a revolutionary product—and it's easy to apply.'

"'What is it, Mike?' I asked, trying to learn what he was peddling so I could get back to work.

"'My insulation was developed after studying the modes of propagation, which, as you know, are convection, conduction and radiation!' he hedged. 'In working with the inverse square laws, I've done some interesting measurements of thermal radiation on lines covered with my insulation. You'll also be pleased to know I applied Prevost's theory of exchanges.'

"'What's the stuff made of?' I asked again, starting to get a hot bearing from his grinding away.

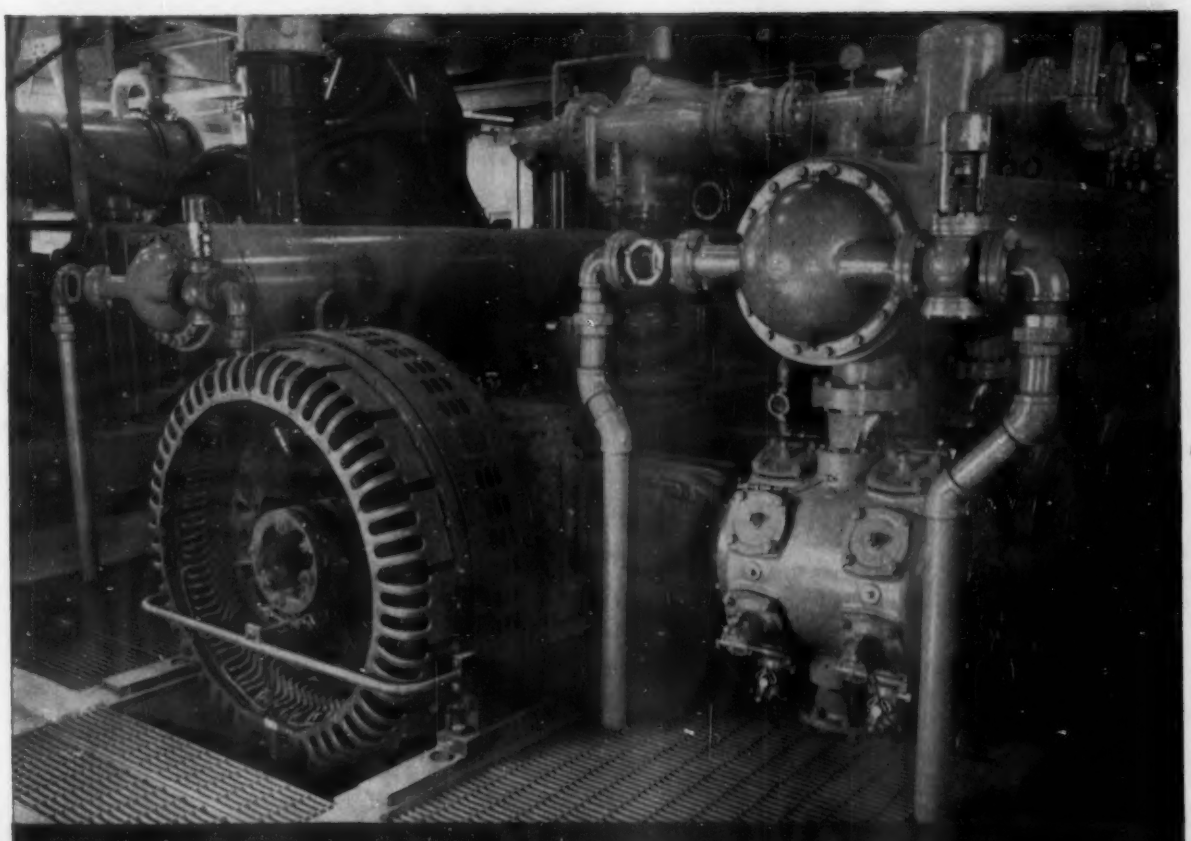
"'But,' he blasted on, 'absorption, transmission and reflection of heat are interesting subjects, Mr Surfaceblow, and I've explored them to the fullest before placing my product on the market. First, I'd like to give you my theory on absorptivity, then reflectivity and last transmissivity, before going into emissive power, to show you what my insulation will do for you. Then, with the aid of Kirchhoff's law, I'll explain that only my insulation will solve your problem.'

"By that time he had me on the ropes. But he raved on. 'Radiation and temperature and radiation and mass are usually overlooked by insulation manufacturers, but all this plays an important role in my magic insulation.

"'What in hell's your stuff made of?' I asked, getting ready to give him the deep six. 'What's it made of?' he echoed, 'why, naturally, Mr Surfaceblow, I can't tell you that—you see it's a trade secret. But you'll be pleased to know that my product is an insulating paint,' he answered to my surprise.

"'PAINT?' I echoed.

"'Yes sir, paint. Don't forget, now—it's *insulating* paint,' he emphasized. 'IT LOOKS like ordinary paint though—and it's APPLIED like ordinary paint. It



**CLARK BALANCED/OPPOSED COMPRESSOR**

# Used for testing jet components in Bendix Aviation's new research center

Speeds up to supersonic levels! Atmospheric conditions ranging from sea level to 80,000 feet! Temperatures from minus 100° F. to plus 800° F. These are the conditions at which Bendix Aviation Corporation's new research facility at Teterboro, N. J. can test component equipment for jet aircraft and missiles.

Destined to save thousands of man-hours of engineering research, the new facility utilizes the latest combinations of pneumatic and electrical equipment. Playing an important part is a Clark 600 horsepower CMA-6, Motor Driven, Balanced/Opposed Compressor which supplies air at 200 psi for test purposes.

Because of the nature of the operation, perfect balance and accurate match of supply to demand, through flexible compressor cylinder loading, were important considerations in the selection of a Clark unit. Compactness saved considerable floor area.

A complete Clark line of Balanced/Opposed Compressors in the 150 to 4500 horsepower range is available in various cylinder arrangements to meet practically any requirement. A Clark representative will gladly furnish complete details. Write for Bulletin 118.

**CLARK BROS. CO. • OLEAN, N. Y.**
*ONE OF THE DRESSER INDUSTRIES*
Sales Offices in Principal Cities Throughout the World

*PRECISION BY THE TON*

**CLARK**
**compressors**

# How to look at 500 lbs. of steam *safely*

Safeguard your eyes from scalding steam and flying glass. Watch your water level safely through SONDERGLASS, the safe gauge glass. Virtually two tubes in one . . . the outer hardened to resist cold drafts and erosion . . . the inner to withstand great heat.

Sonderglass has been dipped into 450°F oil and repeatedly plunged into cold water without spalling or cracking.

Today, equip your boilers with the safe glass — Sonderglass — and enjoy the satisfaction of knowing that you have the best.

## SONDERGLASS

THE *SAFE* GAUGE GLASS

PACKING
Chesterton
GUARDED

**NEW PRESSURIZED SPRAGRIP**
**First Effective Treatment for V Belts**

Spragrip is an entirely new development and unlike any other belt dressing you have ever used. It is a permanent type dressing that gives an immediate power boost and will not lose its grip due to aging, oxidizing, glazing or drying out on the belt. Treat your V, flat, round, leather, rubber or fabric belts the easy way. Just press the button on the modern pressurized can of Spragrip and safely spray hard-to-reach sheaves and belts with this power boosting formula. The same formula is packaged in spout applicator cans under the trade name Belt-Flo. Money back guarantee. Write the A. W. Chesterton Co., Everett 49, Mass. for full information.


## MARMADUKE

*Continued from page 180*

goes on no THICKER than everyday paint. And that's why it's so remarkable. One coat is equivalent to two inches of the best magnesia, asbestos, or any other ordinary insulation you can buy—and anyone can apply it with a brush. Why, your most unskilled laborer can apply it—and it'll last for years.'

"'Nothing doing,' I said, before I blew a fusible plug. With that I barged out of the office.

"A week later the purchasing agent called me from New Orleans. He told me Poey had cried to him that I turned his insulation down flat. Said he believed I was passing up a good thing.

"'The trouble with you practical guys is you get all balled up on scientific subjects,' said the PA. 'Mr Poey told me he's willing to let you get to the bottom of insulation science by running a test. So tomorrow he and I'll be out there. Poey is bringing his latest laboratory test instruments. He's going to hook them up to one of your steam lines and show us how much less heat radiation there is from a section of pipe insulated with his material than from our present lagging.

"'OK,' I said. 'I'll be here—always glad to learn.'

"Next day they showed up, along with a half-dozen brass hats from other firms in the area. I learned Poey oiled them for the kill the night before by blowing them to a party. Now he'd show an ignorant operator like me some real high-brow stuff.

"I selected a 168-C superheated water line going to a well. The line was 8 in. in diameter and only a foot off the ground. One of my mechanics removed the 2-in. asbestos cover from a 4-ft length of line, and brushed it smooth with a wire brush. Poey had him paint on his 'insulating paint.' The stuff looked and smelled like linseed oil and lampblack.

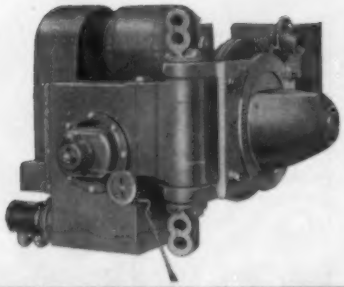
"Then Poey started wiring the painted section up with a lot of fancy instruments he had in his car trunk. There were thermometers in large shiny holders, thermocouples, and a lot of gages and paraphernalia. They all looked phony to me. But the white-collar boys seemed impressed.

"'Your 2-in.-thick insulation will record a much higher temperature than my few thousandths of insulating paint here,' drooled Poey. 'Fact is, I'll prove to you gentlemen—and to our very able chief engineer here—that my insulating paint will show a temperature of not more than six degrees above ambient.'

"'How long will your stuff take to dry?' I asked.

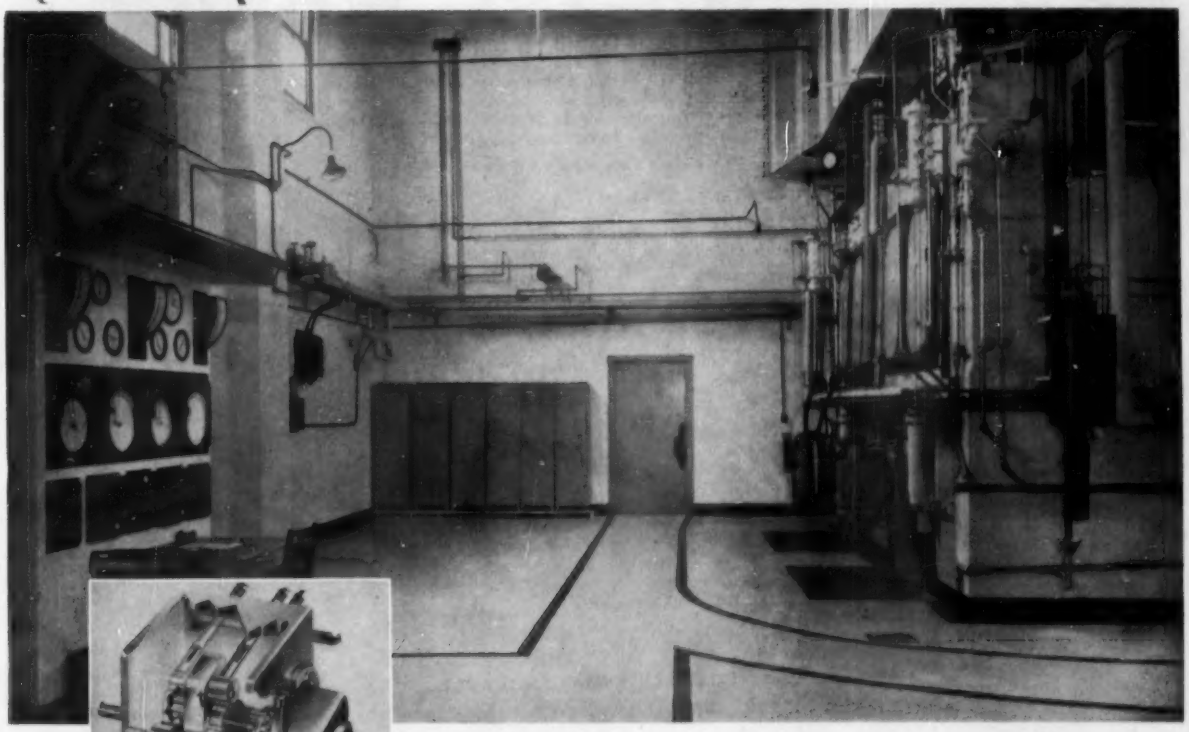
"'Why, it's dry now,' said Poey, 'with

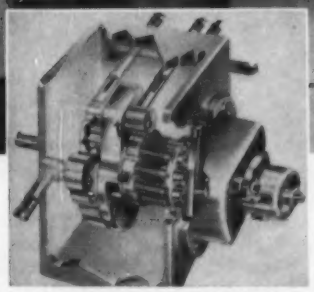
(*Continued on page* 188)



# Saving: $3500 a year

## with Iron Fireman Rotary Oil Burners firing No. 6 oil





**Fires any weight of oil without special adjustment**

The Iron Fireman Oil Volumeter is a variable volume metering pump submerged in the oil reservoir. Oil feed rate is controlled with extreme accuracy (within ½ of 1% of setting) regardless of changes in oil viscosity. Oil is measured by volume, not by valves or ports.

**St. Therese's Hospital, Waukegan, Illinois reports on Iron Fireman heavy oil burners after 4 years use.**

This fine boiler room is 100% automatic. Full modulating fire control provides the exact volume of steam required to meet the varied demands of a fluctuating load. No slow pick-up or wasteful over-firing. Sluggish heavy oils (No. 6) are regulated with extreme accuracy by the Iron Fireman Oil Volumeter (see picture at left).

Actual cash savings of $3500 have been reported by Mr. George Juppe, Chief Engineer. About $500 of this sum is attributed to savings in maintenance costs—an indication of Iron Fireman dependability.

"Our burners have proved very reliable over a wide range of operation," says Mr. Juppe. "Their high efficiency is not affected by variance in the quality and temperature of the fuel oil."

Send this coupon for more information, or see your Iron Fireman dealer.

**Iron Fireman**

AUTOMATIC FIRING FOR OIL, GAS, COAL

**Iron Fireman Manufacturing Co.**
3042 W. 106th St., Cleveland 11, Ohio
In Canada: 80 Ward St., Toronto, Ontario

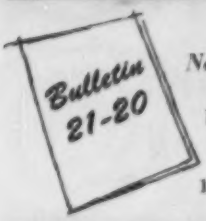
Please send detailed information on the Iron Fireman line of industrial burners for oil, gas, or oil-gas combination, including package burner units with forced or natural draft.

Name _____

Address _____

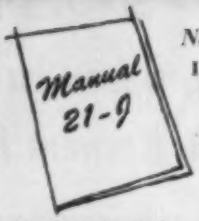
City _____ State _____

# BIDDLE *Instrument News*




*New*
**MEGGER® INSULATION TESTERS 5,000 and 10,000 VOLTS**

Complete presentation of Megger® line of Insulation Resistance Testers. Featuring new high range motor-driven and rectifier-operated testers. One model with a range up to 100,000 megohms at 5,000 volts. Another model with a range up to 200,000 megohms at 10,000 volts.




*New*
**INSTRUCTION MANUAL for MEGGER® INSULATION TESTERS (Fifth Edition)**

Nearly 80,000 of the previous copies have been distributed to electrical men and educators throughout the U.S. Now expanded to 100 pages, the new Instruction Manual 21-J devotes 14 chapters to a complete education for the practical man who is responsible for electrical equipment.

*New*
**BIDDLE CORONA TESTING EQUIPMENT**

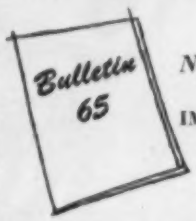
Describes three models for non-destructive evaluation of electrical insulation for testing transformers, cables, capacitors and other electrical components for ionization starting voltage at 60 cycles.

*New*
**BIDDLE MOTOR and PHASE ROTATION TESTER**

Describes instrument for determining direction of rotation of electric motors before they are connected to the line. Also, to determine phase rotation or sequence of energized power circuits.

*New*
**BIDDLE DIELECTRIC TEST SET**

Describes Model 1-40 KV for measuring d-c current at voltages up to 40 KV when applied to the insulation of such equipment as generators, transformers, bushings and cable.




*New*
**BIDDLE IMPULSE CABLE FAULT LOCATING EQUIPMENT**

Describes three models of cable fault locating transmitters now available. Also describes detector and accessory equipment.

**YOU MAY HAVE ONE OR ALL WITHOUT CHARGE**

**JAMES G. BIDDLE CO.**

• ELECTRICAL TESTING INSTRUMENTS
• SPEED MEASURING INSTRUMENTS
• LABORATORY & SCIENTIFIC EQUIPMENT

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PHILADELPHIA 7, PA.

Please mail me: ☐ Bulletin 21-20 ☐ Manual 21-J ☐ Bulletin 66 ☐ Bulletin 80 ☐ Bulletin 22 ☐ Bulletin 65

*Name* _____

*Job* _____

*Company* _____

*Address* _____

8429-P


## MARMADUKE

*Continued from page 182*

168-C water inside the line, it couldn't be otherwise.'

"'In that case I'll save you a lot of trouble,' I informed him, and started taking off my pants.

"'Hey, what are you doing, Mr Surfaceblow?' yelled the purchasing agent, his eyes popping out of his head.

"'Just taking your advice and getting to the bottom of insulation science,' I informed him. 'Now, Poey here can remove his pants and sit on his painted pipe, while I sit on my asbestos-covered pipe here. That'll get both of us close to our subject and the guy who jumps up first has the poorest insulation.'

"The white-collar boys let out a roar you could hear 200 miles away in New Orleans. I sat down quickly on the asbestos in my drawers—but Poey only stood there staring at his painted pipe and scratching his head. For the first time since I met him his mouth was closed. Then he grew a lobster red around the gills. All of a sudden he started yanking his instruments off the pipe and throwing them into his trunk. Then he hopped aboard and shoved off, foaming at the mouth.

"That's the last time I ever saw Poey," wound up Marmy, turning back to his desk. "Education is great stuff, but if you can't prove your science with horsesense, then it's time to give your book learning the deep six."—*SME*

### Marmy's Mailbox

Smooth sailing and fair winds always to Old Storm and Strife Marmy. Inclosed is $2.00 for two copies of The Marmy Story.

W J Perowitz *San Diego, Calif.*

Just read "The Quonset Receiver Tank" in July Power. It's the finest Marmy story I've read and one of the dog-gondest best yarns I've heard spun anywhere, anytime. Marmy is a high spot that keeps Power plopping down on my desk, by request, month after month. I look forward to him.

Jim Kohler *New York, N. Y.*

## Modernization Awards

**To learn how you can win recognition for your accomplishments, see pp 80-81.**

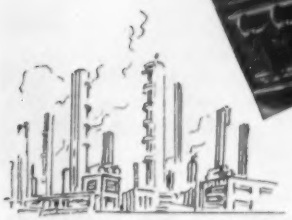
# THIS 400,000 Pounds per HOUR

# Vogt

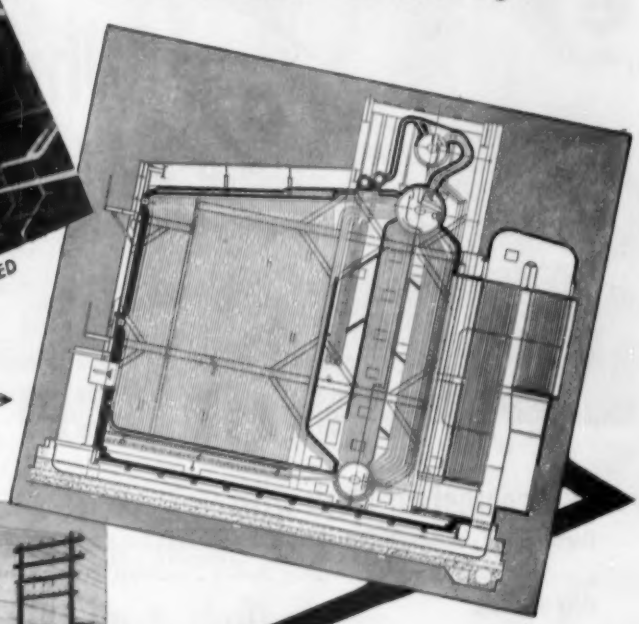
## STEAM GENERATOR

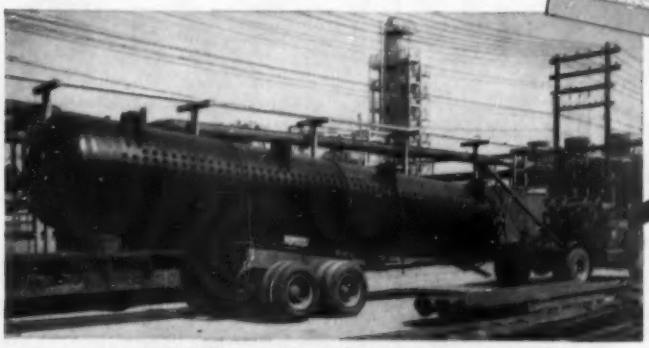
### Gives Top Performance in a Leading Texas Petroleum Refinery

VIEW OF THE COMPLETED STEAM GENERATOR



RIGHT →
LONGITUDINAL SECTION THROUGH THE UNIT.





6'-6" DIAMETER x 37'-0" LONG STEAM DRUM BEING TRANSPORTED TO THE ERECTION SITE DURING INSTALLATION.

**PRINCIPAL DATA**

400,000 pounds per hour capacity.

Fusion welded steam and water drums designed for 700 lbs. S.W.P.

Superheater delivers steam at 750°F. total temperature.

Water cooled furnace.

Burners for Oil and Acid Sludge fuel.

Vogt builds a complete line of bent tube steam generators designed to burn solid, liquid, or gaseous fuels to meet specific operating conditions. Write for bulletins.

**HENRY VOGT MACHINE CO., LOUISVILLE 10, KY.**

**BRANCH OFFICES: New York, Philadelphia, Chicago, Cleveland, St. Louis, Dallas, Charleston, W. Va.**

Why

do most users

prefer and buy the genuine

RIDGID

PIPE WRENCH?

**It's easiest to work with...** perfect balance . . . comfort-grip I-beam handle . . . handy pipe scale on hookjaw . . . easy-spinning adjusting nut . . . clean grip on pipe, no slip or lock.

**It lasts longer...** first guaranteed housing, won't break or bind . . . ever. Every wrench individually tested before shipment . . . and millions of them in use. Sizes 6" to 60"—end pattern, 6" to 36".

For the most for your money, buy RIDGID . . . Your local Supply House stocks them for you, delivers them fast!

THE RIDGE TOOL COMPANY • ELYRIA, OHIO, U. S. A.

RIDGID

Work-Saver Pipe Tools

## BURNERS, STOKERS

Continued from page 89

through the furnace walls, especially in an air-cooled furnace.

The fish-tail burner gives a slow long-path flame travel as coal falls toward furnace bottom, then turns up to pass into the boiler tubes. The slow velocities and rich fuel primary-air mixtures combine to make flame from this burner quite stable.

One or more horizontal-turbulent burners are installed in a side or front furnace wall, much like an oil or gas burner. Deflectors or spirals in coal primary-air nozzle give the entering fuel stream a spin. Secondary air enters around the fuel stream. An adjustable valve in the burner makes the secondary air spin, too.

This burner gives a highly turbulent short-burning flame. Fuel-air proportions are critical, if you expect flame stability and want complete combustion before gas leaves the furnace.

The corner-fired tangential type is the third pulverized-fuel burner. With this arrangement, one or more burners are set in each corner of a square furnace. The entering fuel primary-air streams are tangent to whirlpool of flame in the center of the furnace. Secondary air enters above and below each coal primary-air stream.

Sometimes you can adjust vertical angle of burners to vary flame height and control steam temperatures to a degree. This burner gives good mixing and stability, and allows a long time for completing combustion.

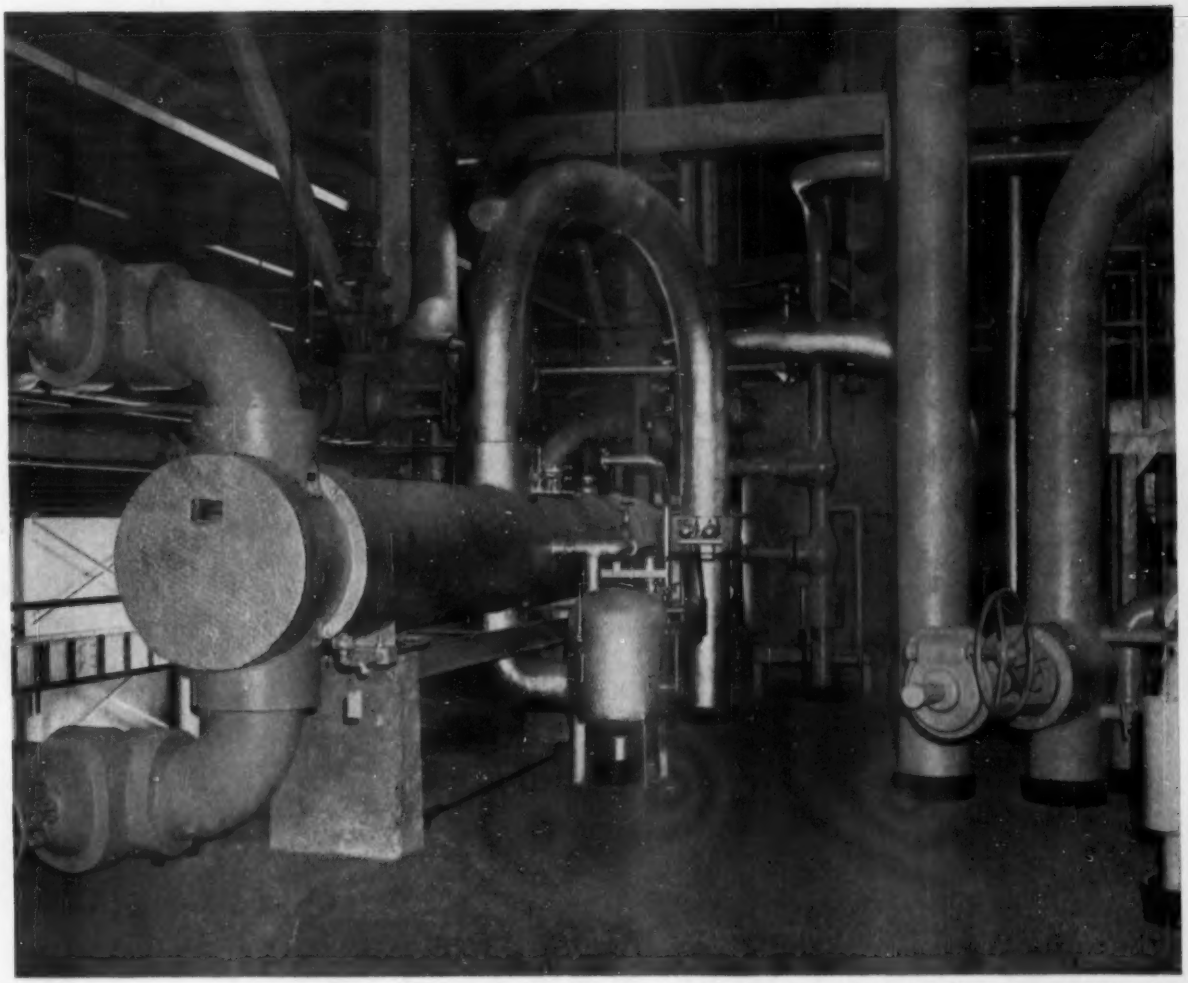
You need a fair-sized and practically square furnace to use the tangential burner successfully. Some troubles have been encountered with external wastage of furnace-wall tubes because of air deficiency where flame washes the walls.

**Operation.** When boiler has a number of burners, make frequent inspections and adjustments, if necessary, to equalize quantity of coal passing through each. Try out the various adjustments to get the best and most evenly distributed flame.

Flame should not impinge heavily on burner throat or on adjacent furnace walls or tubes; combustion should be complete when gas strikes the first watercooled surface. For stability, ignition should start not more than a foot from burner wall. To avoid interference with flame shape, remove slag deposits in front of burners.

**Lighting off.** Oil or gas torches are commonly used for lighting off. In turn, the torches are lit by either (1) oil-soaked asbestos wicking wound on a rod and inserted through inspection ports or (2) an electric-spark igniter.

Take care to keep air velocity through burner being lighted at a low value so



This evaporator-condenser unit in a modern power plant is insulated with "Featherweight" 85% Magnesia.

# "Featherweight" 85% Magnesia insulation conserves heat and dollars

"Featherweight" 85% Magnesia (85% basic carbonate of magnesia and asbestos fiber) effectively insulates piping and equipment with temperatures up to 600° F. Used with a primary layer of K&M Hy-Temp Insulation (Diatomaceous Silica), the combination is effective up to 1900° F. The application of these two layers—with staggered joints—eliminates the heat loss that normally occurs when expansion causes the joints to open in single layer installations.

These K&M insulations last the life of the equipment they serve. They withstand moisture, vibration and frequent temperature changes.

New and now available is "Featherweight" Water-Resistant Magnesia Insulation for temperatures up to 450° F. It is used underground where severe water exposure may damage the insulation or on indoor steam heated lines and equipment where high humidity and moisture are present.

For more information on these heat-saving, money-saving K&M insulations, contact your K&M distributor who is an experienced applicator. Or write directly to us.

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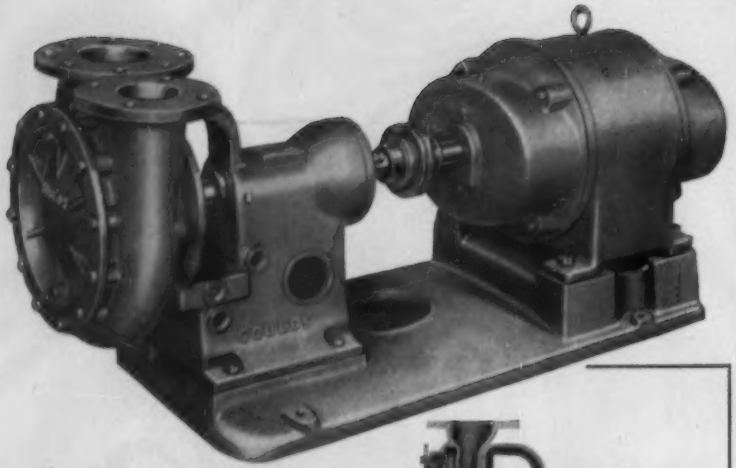

The entire fluid end of this chemical pump is available in any of the following metals: 316, Gould-A-Loy 20, 304, all iron, all bronze or bronze fitted, all iron with stainless trim. Nine sizes ranging from ¾" to 3"; capacities up to 720 GPM; heads to 200 ft.

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**Bulletin 725.4** describes *all* the operating and maintenance advantages of the Goulds Fig. 3715 chemical pump. It defines the extensive standardization this design accomplishes for simplifying your parts inventory. It gives you detailed performance curves. We will be glad to send you a copy. Just write for Bulletin 725.4.

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# BURNERS, STOKERS

Continued from page 190

torch flame or partially lighted coal flame is not blown out. Usually, air entering the furnace from other burners makes up any oxygen deficiency at the one being lit.

Adjust air and coal supply to give a stable flame without too much smoke. After lighting each successive burner, adjust coal-air relation for all others if necessary.

Best practice is always to use a lighting torch. Sometimes, where they are closely adjacent, you can light one burner from another. But this practice is not safe and it is often dangerous.

Immediately after shutting off a burner, blow it out thoroughly with air. Otherwise, heat radiated from adjacent units may char or ignite the coal dust remaining.

When the idle burner is next lighted, fire may burn back through it and into the coal-air piping, damaging burner castings and making the unit inoperative. To stop such fires, cut off coal-air flow, then try to loosen the caked coal by hammering on piping and by blowing out burner and piping thoroughly with an air hose.

If coal-air mixture is too warm leaving the pulverizer, it may become sticky, caking on pipes, distributors and burners. Usual top limit is 140-170 F, depending on coal characteristics.

While inlet-air temperatures are not too critical, usual practice keeps them below 600 F. Inlet air must be hot enough to dry wet coal for proper pulverization fineness and capacity.

### STOKERS

Many different types of stokers have been developed to handle various sizes and kinds of coal. Four well-known types are underfeed, overfeed, spreader and traveling grate. The first two have had difficulty with clinkering and uneven coal sizing. The last two have fared better and are presently quite popular for small and intermediate-size boilers.

Traveling-grate stokers are especially good for burning hard-grinding low-volatile fuels like anthracite, coke breeze.

Spreader stokers work best with medium- or high-volatile fuel having low ash-fueling temperature.

**For low maintenance cost** with any stoker, sustain air flow through the grate to keep the metal from overheating. Smooth fuel beds help provide uniform mixing of fuel and air. Clinker formations, heavy, fine, wet or unevenly sized fuel or improperly adjusted drafts can cause overheated grates and air maldistribution.

It takes considerable operating skill to burn fuel completely without passing

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# BURNERS, STOKERS

Continued from page 192

an excessive amount of air through the discharge portion of the grate. For best results, use the coal your stoker is designed for. Operator can only partially compensate for differences in coal consumption, moisture and sizing by adjusting stoker feed, stroke and air supply.

Arrangement of coal bunkers, chutes and hoppers sometimes causes segregation of various coal sizes, which can affect fires considerably. Check into this in case of trouble.

Clean the air chambers below the grates regularly, to prevent accumulations of siftings that block off air flow. Check for symmetrical arrangement of forced-draft fans, ducts and dampers, as this is important for even air distribution across the stoker width.

**Starting up.** Run the stoker until grates are partially covered with coal. Then put a quantity of light wood and some oily rags or paper on top and ignite under a light draft. As the coal catches on fire, increase feed and draft to desired burning rate.

Under operation, heat output is largely a matter of the amount of air supplied. Regulate coal feed to maintain a fuel bed thick enough to prevent blowing holes in the fire, yet thin enough to burn out by the time it reaches discharge end of the stoker.

Clinkers can either cause holes in the fire or block the air flow, resulting in poor efficiency and loss of capacity as well as possible burning of the grates. It's best to remove large clinkers. But do it with a minimum of disturbance to the fire, or more clinkers may result.

When shutting down a boiler, reduce coal supply so most of the fuel on the grates will burn out by the time you have no more demand for steam. This minimizes popping of safety valves after plant is shut down.

You can "bank" the boiler by leaving the rear end of the stoker covered with ash and feeding only a small amount of coal with a very light draft. Boiler will remain hot and ready to pick up load again quickly.

**At high ratings,** stokers may smoke and discharge flyash from the boiler. An over-fire air supply with high-pressure air or steam jets for mixing gas with excess air helps reduce smoke and flyash emission. Pressure for these jets is 8 to 20 in. water.

Flyash-accumulating pockets in the boiler passes with means for ready removal will help, and so will dust collectors. For spreader stokers, they are practically essential.

**Other fuels.** Besides coal and lignite, lower grade fuels like peat, wood waste or straw are sometimes burned. These

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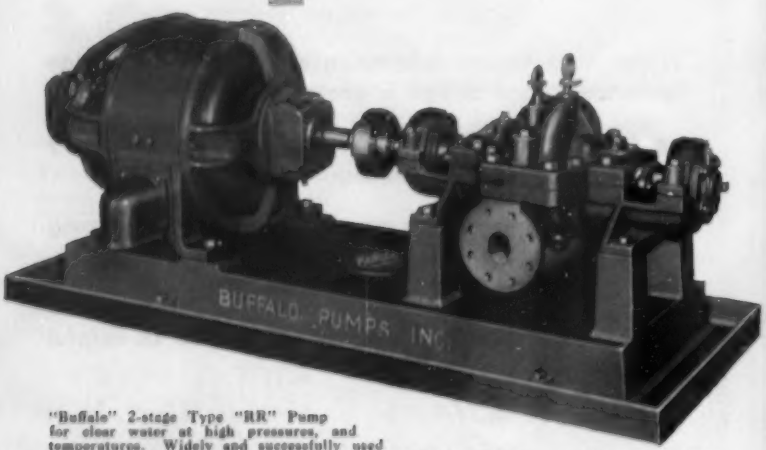
NOTE: The "Buffalo" Pumps line is complete! There's a design for almost any liquid you may handle, under a wide range of hydraulic conditions. Let us know your problem—we'll mail you literature on the right pumps!

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## BURNERS, STOKERS

*Continued from page 194*

fuels have a high percentage of moisture that must be driven off before combustion begins.

This type fuel is burned in a dutch-oven furnace. The roof and throat reflect heat back onto the fuel, which lies in a conical pile on the grates. Combustion rate depends first on amount of air supplied, and second on whether fuel pile covers the grates.

Fuel is usually fed from the top, although an underfeed mechanism has shown promise recently. Combustion of gas is completed in a secondary combustion chamber. Some units employ spreader stokers in burning hogged wood waste.

As the qualities of the lower-grade fuels vary widely, there are few general principles about burning them. Here are some recommendations: (1) Reflect back enough heat to dry and distill off gases and moisture. (2) Adapt size and shape of both furnace and fuel pile to fuel being burned. (3) For best efficiency, feed fuel steadily and with a minimum of air leakage. (4) Avoid ash slagging or clinkering on the grates. Use water-cooled grates, or keep water standing in the ashpit below the grates.

Do not hold fuel in storage more than three or four months. It may deteriorate rapidly, losing its heating value.

## ARGUMENTS

*Continued from page 138*

standing in front of the fire door when the cap blows off. I'll admit that wooden plugs sound worse, but they are not.

The "book" is silent on the subject because the people who wrote it would not think of this unconventional repair. Or, if in their unregenerate past they were guilty, they are usually most reluctant to admit the fact.

DAN ROYER *New York, N. Y.*

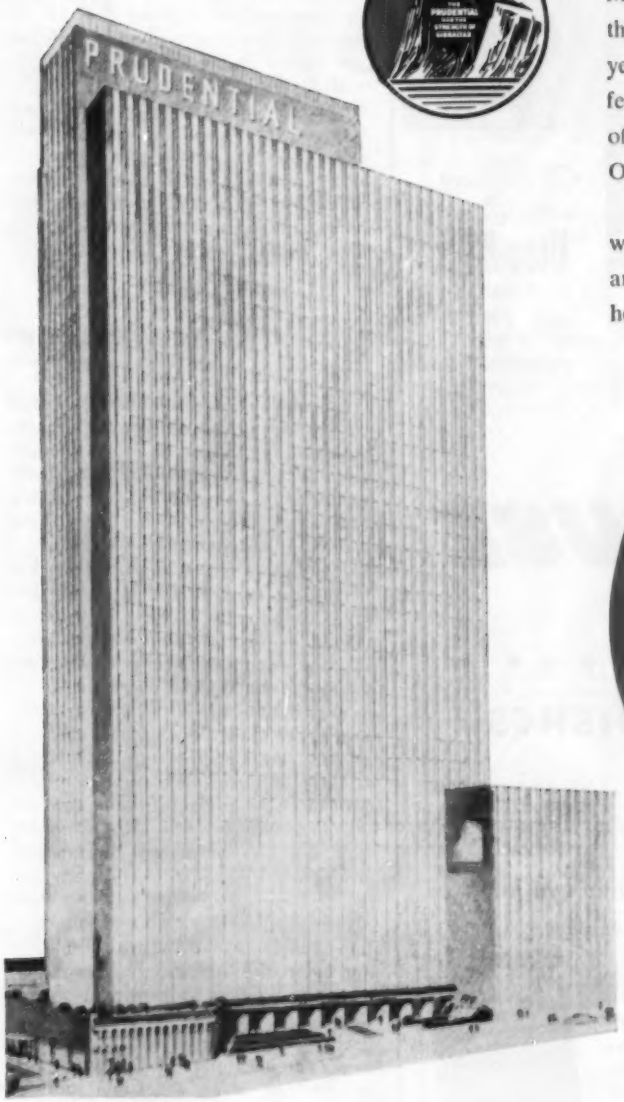
WHEN YOU'RE on the spot, act like the Dutch boy who used his finger to stop a leak in the dyke. Take the best available means and apply it.

I assume, of course, that Davis (July *Arguments*) considered the one defective tube a "small" leak that did not affect the factor of safety. The main problem was to maintain a safe water level. Naturally, this must be recognized as an emergency measure only, and again we assume that he gave detailed instructions for more than the usual attention.

An important point is to determine cause of leakage. Prepare the boiler for a thorough internal and external inspection at the earliest possible date.

J A SHANNON *New York, N. Y.*

# ERIE CITY *boilers used by* Prudential in CHICAGO

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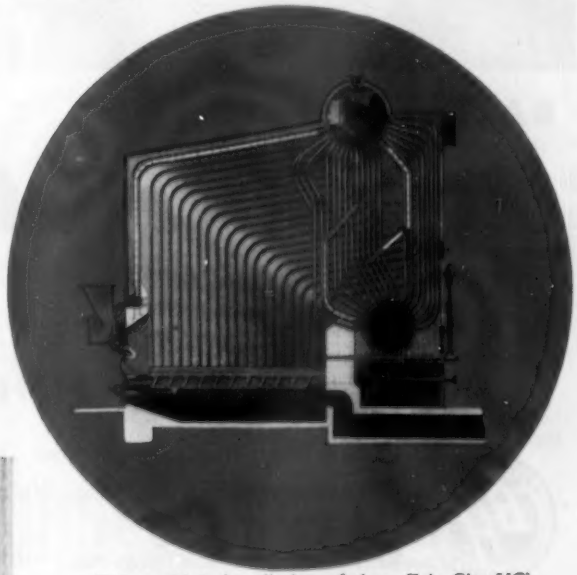
Modern, Erie City VC Steam Generators will satisfy the heating load for the most modern office building yet projected. The Prudential Building, soon to rise 600 feet into the Chicago skyline, is the very last word in office facilities. Prudential's new Mid-America Home Office is one of the largest office buildings in Chicago.

Erie City VC's, the last word in compact, completely water cooled steam generators will provide flexibility and economy of operation in meeting a variable steam heating load.



This multiple installation of three Erie City VC's, fired by Detroit spreader stokers, features completely water cooled furnaces—offers high capacity in a compact design. Erie City VC's save space, economize installation and maintenance costs. They permit a high degree of flexibility and quick response to load changes. Request Bulletin VC-4.

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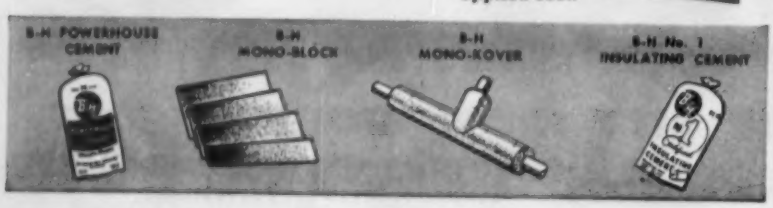


## FISH IN COOLING WATER

Continued from page 79

that may trap fish. Bar racks about 25 feet in front of screens protect them from heavy floating debris.

The screen forebay allows free movement to fish so they can move away laterally out the sides or back out the front of the screen structure. Tidal currents moving up and down the bay have a clear sweep across the screen fronts. Re-entrant corners have been eliminated and everything possible has been done to assure uniform water flow in the forebay. Velocities are less than ½ foot per second in this area.

High turbulence and abrupt velocity changes have been avoided in the cooling-water system in the station. Downcomers of the condensers move the water as a column. Maximum velocity in the system is about 8 feet per second. Fish pass through the plant in about five minutes.

## STEAM TRAPS

Continued from page 87

tions when choosing a factor. Since condensate capacity of a trap decreases with rise in condensate temperature, it is important to know the condensate temperature base of capacity tables. The lower this base, the higher the safety factor that must be used.

**Installation.** Every manufacturer has prescribed methods for installing and maintaining his trap. Instructions should be carefully followed. Certain installations pointers, however, are excellent guides to good operation.

(1) If physically possible, install trap below equipment drained so there is positive flow into the trap. (2) Use a strainer ahead of each trap. Strainers with clean-out plugs provide a convenient point for blowdown of dirt. Some trap designs incorporate an integral strainer.

(3) Where condensate is to be lifted above trap level, install a check valve immediately beyond the trap discharge and before the riser, Fig. 1A. (4) When a trap is exposed to freezing temperature, be sure it is freeze-proof. A self-draining trap is preferred. Insulation can sometimes prevent freezing. (5) Install trap in an accessible location for easy maintenance and inspection.

(6) Use an individual trap for each coil of a multiple group or on each unit of apparatus, Fig. 1B. This insures correct and balanced drainage at all times. (7) Except for certain thermostatic traps requiring a cooling leg, install trap close to unit being drained.

(8) Use a water seal, Fig. 1C, to prevent steam binding when condensate is

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## DIAPHRAGM VALVES FOR STEAM AND LIQUIDS

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T-900 Remote Bulb Master Thermostat. *Send for Bulletin T-900.*

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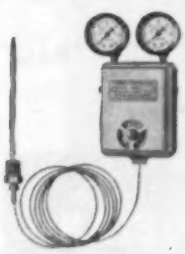
T-403 Single Temperature Thermostat. *Send for Bulletin T-403.*

T-460 *Dual* Two-Temperature Thermostat. *Send for Bulletin T-460.*



Series T-800 Thermostats for steam, liquids or air. Proportional or two-position action. Furnished with remote bulb for liquids or air; rigid stem models for insertion or immersion. Separable sockets available. *Send for Bulletin T-800.*

V-108 Three-Way Mixing Valve for mixing liquids of varying temperatures. Thermostatically controlled. Sizes 2½" to 10". Rubber diaphragm. *Send for Bulletin V-108.*

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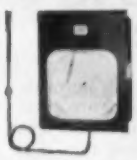

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## STEAM TRAPS

*Continued from page 198*

elevated to the trap and it is impractical to have a drain connection at the bottom of the apparatus. Fit a check valve to prevent back-flow. (9) Pitch horizontal runs slightly toward the trap, particularly when the line is oversized compared with the quantity of condensate it handles. This minimizes the possibility of steam binding.

(10) Install a check valve beyond each trap when a number discharge into a common header, Fig. 1B. This prevents flooding of shutdown units. (11) For steam mains, use a trap at each low point, with not more than 500 ft between traps. Also fit them at low points on headers and ahead of pressure-reducing and other regulating valves.

(12) The first and second banks of coils require larger traps than the remainder, Fig. 1E, as do multiple-roll ironers. (13) Be sure steam pressure *at the trap* is known. (14) Discharge to a point no higher than the lowest line pressure can lift condensate from the trap to the point of discharge. Multiply lowest line pressure in psi by 2 to determine maximum allowable height in feet.

(15) Check inlet and outlet markings. (16) Blow down the line to remove scale, dirt, etc, before the trap is installed. (17) Fit valves and unions before and after the trap to permit easy removal, Fig. 1D.

Never use a pipe smaller than the trap inlet size between the trap and the equipment drained. (19) Size the return line to prevent excessive backpressure. (20) If possible, use a T fitting with a valve to permit checks of trap operation. (21) On certain kettles, Fig. 1F, install trap at lowest point to prevent steam locking. (22) One trap drains a group of parallel heating pipes when they are properly and adequately manifolded. Be sure it is installed at the lowest part of the manifold, Fig. 1G.

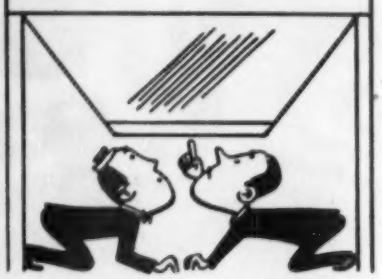
Steam traps usually represent a small investment when compared to the equipment they drain. However, the efficiency of steam apparatus depends to a large extent on the proper functioning of steam traps. This fact highlights the need to select and install right.

## CONTROL VALVES

*Continued from page 111*

prevent leakage. If repacking is necessary, make sure you replace it with the correct type. And before going ahead with repacking, examine valve stem to see if it has been marred or scored with a pipe wrench. Such carelessness can


The case of the stymied cinders...



In a Cincinnati outfit handling cinders by the hundreds of tons, production reached a deadlock. Arching and bridging stymied the cinders in their normal course through the bins.

But once again a CLEVELAND vibrator on the sloping side of the bins put an end to costly bottlenecks and equipment downtime.

*Tell us about your particular stymie, or ask for our detailed literature. We're sure there's a CLEVELAND to fit your requirements.*

**AIR *and* ELECTRIC**

**2824 Clinton Avenue • Cleveland 13, Ohio**

Zallea-designed Expansion Joints assure positive protection from damage caused by pipe movement. The units shown here—gimbal, hinged, and universal types—absorb pipe movements in any direction, imposing minimum forces on adjacent piping, equipment and anchors. An original Zallea development, gimbal expansion joints permit angular movement in any plane, with gimbal ring and hinges built to withstand pressure thrust and to support piping.

Zallea already has, or will design, expansion joints for every service—and to suit any piping layout. Test records show that Zallea Expansion Joints outlast all other packless joints by as much as 1800%. For information on standard types, or consultation on special expansion or piping problems, ask to have a Zallea representative call.

**Zallea** *expansion joints*

ZALLEA BROTHERS, 814 LOCUST STREET, WILMINGTON 99, DELAWARE

*World's Largest Manufacturers of Expansion Joints*

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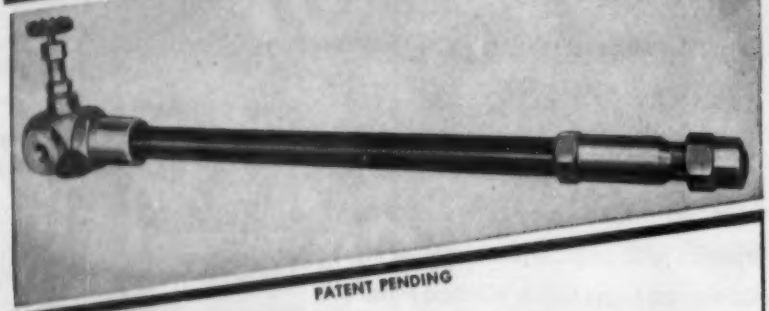
of the steam and mechanical types now combined into

## DUAL STAGE BURNERS



PATENT PENDING

Now, at last, the inherent advantages of *both* systems of fuel oil atomization are *profitably* yours . . . within the one, new NATIONAL AIROIL Dual Stage Burner.

42 years of combustion equipment design and manufacture are in back of the Dual Stage Oil Burner . . . and, it has been thoroughly tested and proved in the field for firing: Petroleum Processing Heaters; Rotary Kilns; H.R.T., Scotch Marine and Water Tube Boilers; etc.

Available in three sizes, the NATIONAL AIROIL Dual Stage Burner fires all grades of fuel from No. 2 to No. 6, with a ready capacity of 80 to 300 g.p.h. Further, for a perfect flame pattern, we would recommend using with the Dual Stage Burner either the NATIONAL AIROIL Universal Register for forced draft or, the NATIONAL AIROIL Tandem Unit for natural or induced draft furnaces.

Get detailed description, illustration, and specifications in NATIONAL AIROIL Bulletin 25.

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SLUDGE BURNERS, Steam Atomizing
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**INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT**


## CONTROL VALVES

Continued from page 200

easily ruin the seal. Several field men suggested that even when packing is OK, it's a good idea to replace it while valve is out of service—especially if packing is old.

Teflon packing, without lubricator, does a good job below 450 F. Caution: Valve stem must be absolutely smooth for Teflon, to avoid leakage. Where fluid temperature is greater than 450 F, a cooling fin carries heat away from the stuffing box. Also, use a high-grade asbestos self-lubricating packing. For superheated steam, aluminum-foil packing is often specified.

Valve seats give little trouble if valve has been sized correctly and right material is used.

As final item of session, Hal Kinney called attention to regular check of diaphragm to make sure it stays soft and pliable. Stiffness is usually result of high-temperature action on neoprene (reinforced with cotton duck) diaphragm. Where local temperature is very high, silicone diaphragm can be used to advantage.

## FAN DRIVES

Continued from page 117

accurate check on level.

While unit is shut down, examine for signs of excessive oil leakage and make repairs where necessary, to prevent abnormal lubricant loss.

**Initial operation.** Follow this procedure to insure subsequent satisfactory performance: (1) Recheck oil level. (2) Recheck alignment. (3) Turn fan by hand to be sure there is no binding or interference. (4) Jog switch to check rotation. (5) Start operation, listening for unusual noise. (6) After a week, drain oil, flush reservoir and refill with filtered or new oil. Recheck alignment.

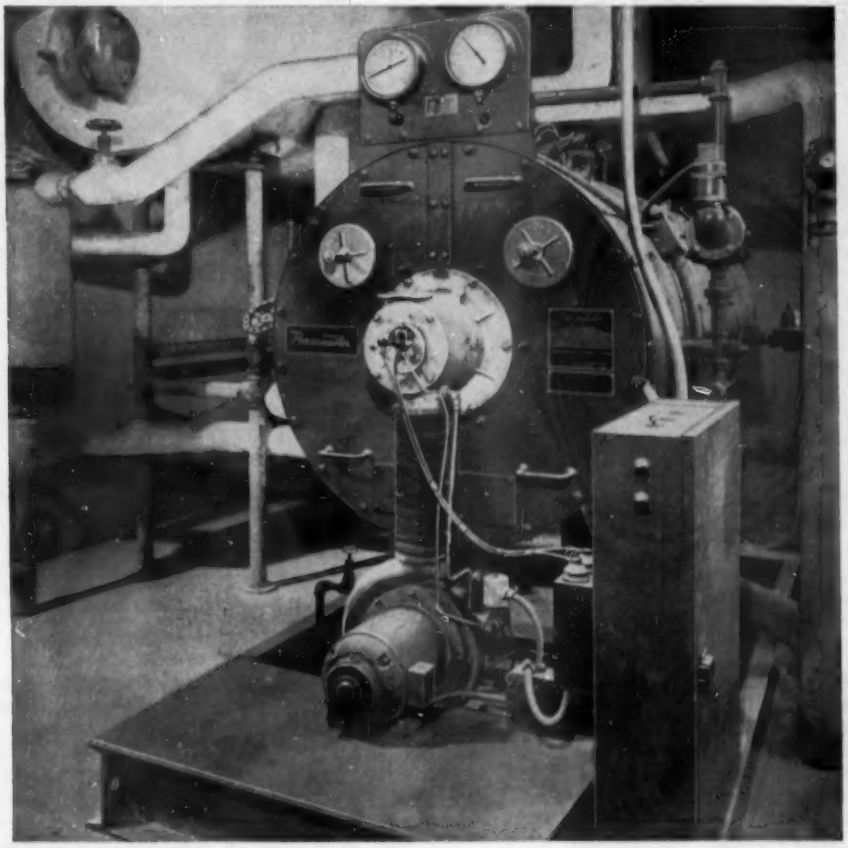
**Shutdown protection.** During long shutdowns, internal gear parts are subject to corrosion. Best protection is to completely fill the unit with oil. Covering with a tarpaulin helps protect against the weather. Before restarting, withdraw enough oil to restore proper level.

An alternate means of protection is to run fan at least once a week to coat internal parts with an oil film.

**Starting in winter.** Be sure lubricant is fluid enough. Usual practice is to select a cold-weather oil that has a pour point as low as the minimum ambient temperature. For practically continuous operation, you may use the same viscosity lubricant year round.

When ambient temperature is below

# in CHEMICAL INDUSTRIES



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FOR EXAMPLE: The Davison Chemical Corporation's new multi-building fertilizer plant at New Albany, Indiana, is heated entirely by this oil-fired *Powermaster* Packaged Automatic Boiler.

Savings start with *Powermaster's* simplified installation . . . no special foundation or costly stack is required. A factory-assembled packaged unit, fire-tested before shipment, it is delivered complete, ready for operation as soon as fuel, water, electrical and steam connections are made. Other cost-saving *Powermaster* advantages include high fuel economy at all loads, space-saving compactness, dependability, maintenance-saving accessibility, fully automatic operating and safety controls, hospital-clean boiler room and smokeless combustion. *Powermasters* are entirely designed and built by Orr & Sembower, and are rigidly fire-tested before shipment.

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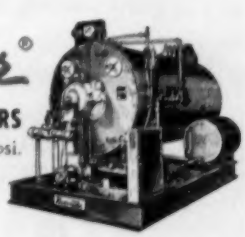
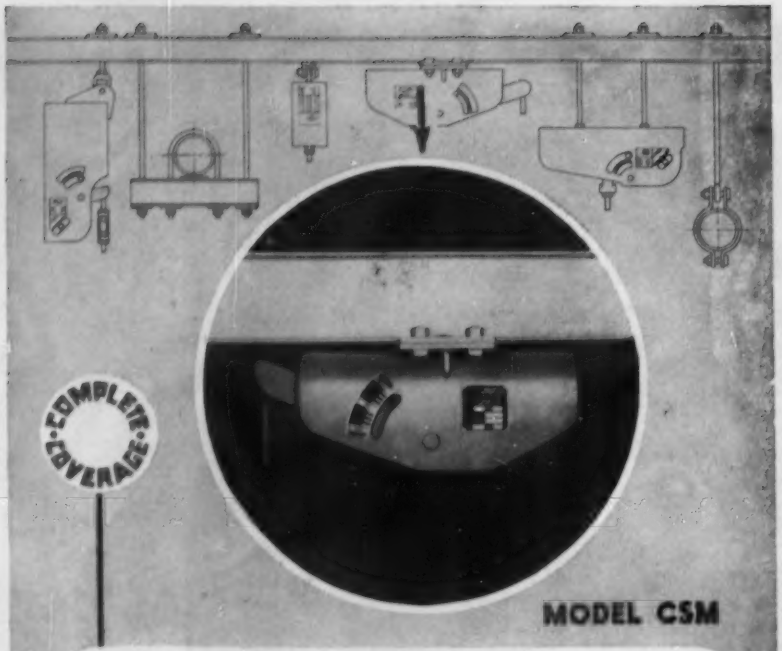
sizes to 500 HP; Pressures to 250 psi.



**ORR & SEMBOWER, INC.** • Established 1885 • **Morgantown Road, Reading, Penna.**




*This is article number 4 in a series dealing with the subject of pipe supports in modern power and industrial plants.*

Previous articles explained details in design and application of constant supports. These covered units intended for heavy loads; as high as 37,000 pounds.

Small piping, such as high pressure boiler drain, instrument and gauge, gas and oil, and chemical and refinery process lines are frequently subject to high temperatures and consequent large travels. The pictured Bergen CSM unit is a small constant support developed specifically to handle such applications. It is available in seven different sizes with a maximum load of 330 pounds. All CSM units have a total travel of 8 inches. Greater capacities are available upon request.

The design of this small constant support makes it particularly adaptable to "tight" head-room conditions. The projecting load arm enables it to be placed above or below the pipe as conditions may dictate.

As in all Bergen Constant Supports, permanently-lubricated needle bearings are employed at principal rotating points. The rugged housing is a structural part of the unit and can be used to secure it to supporting steel in a variety of methods. The housing makes these units particularly suitable for outdoor installations.

All Bergen Constant Supports employ a lower rod connection which permits normal transverse and longitudinal movement without impairing the unit efficiency.

**BERGEN PIPESUPPORT CORP.**
**50 Church Street, New York 7, N. Y.**

BTS

the oil's pour point, admit water to the tower, let it circulate for an hour or so to warm up lubricant before starting.

**Regular maintenance** is of great help in preventing trouble. Actual schedules vary depending on type of equipment, installation and nature of operation, but the basic points to check are these. *Every week*: check oil level and inspect for leaks. *Every month*: drain a small amount of oil from lowest point in reservoir to remove accumulated moisture. *Every three months*: change oil, check coupling alignment, check fan-blade angles.

## SAFETY HEADS

*Continued from page 95*

tems operating at atmospheric or absolute pressures. Main purpose in scoring a prebulged disk is to prevent dislodging metal fragments when the disk functions.

Scored disks are not designed to perform under a constant positive pressure. They are usually adapted to equipment where the disk is normally subjected to atmospheric pressure, and where, when a positive pressure is applied, it continues without interruption up to the disk rating.

Shear-type metal disks, whether purposely sheared before installation or designed to shear under pressure, are not desirable on units where the discharge may endanger personnel or equipment. This type is also undesirable upstream from a relief valve because the sheared disk definitely affects valve operation.

## More PLANT PROBLEMS

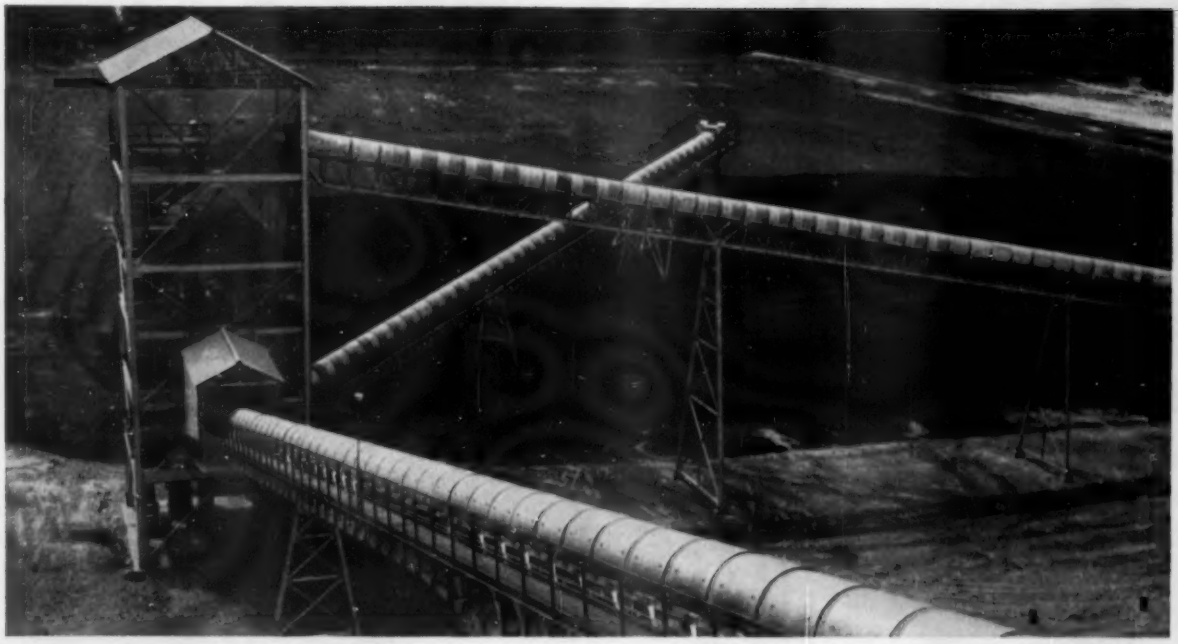
*Begins on page 132*

**Stockpile fires** (*cont from p* 133)

**WE REGULARLY CHECK** our coal with thermocouples and immediately use any at a temperature approaching 150 F. High sulfur content speeds spontaneous combustion, so we purchase coal having less than 1% sulfur. We obtain our coal directly from the mine within four days after it reaches the surface. We wash it and treat with oil. The oil treatment, costing 20c per ton of coal, prevents moisture absorption and generally retards spontaneous combustion.

To minimize coal-pile fires we avoid storage near stacks, hot steam pipes and other heated equipment. We do not buy coal during hot weather and never pile it on top of snow. Seasoned coal is made by weathering before transfer to the main stockpile. We avoid wetting and drying stored coal while keeping it at a height low enough to avoid separation of the fines, which are easily ignited.

Freshly mined coal is especially dan-



# Coal Conveying - - - 26 Carloads Per Day

**Louis V. Sutton Steam Electric Generating Plant • Carolina Power and Light Company**

Temporary interruption of the flow of incoming coal can't interfere with power production at this plant . . . even though it consumes 26 carloads a day. An S-A Conveying System that keeps bunkers full and develops a million-dollar stockpile makes sure of that.

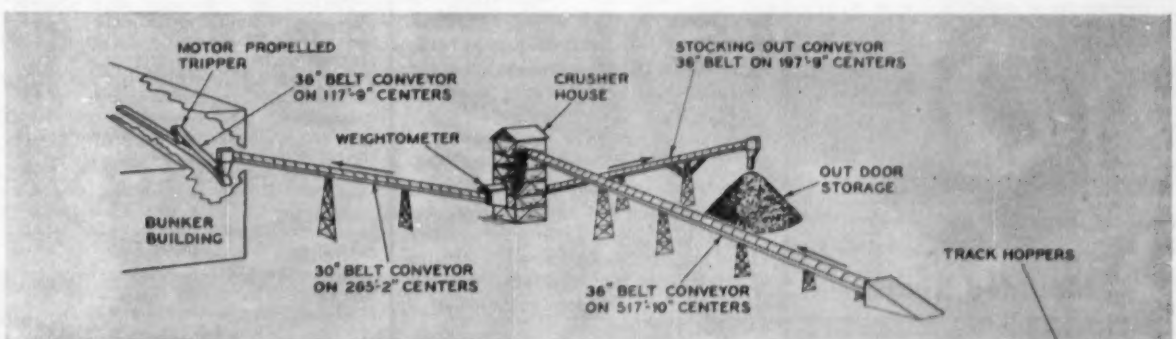
Coal arriving by rail cars is dumped into the track hopper. An S-A slope belt conveyor takes it, 450 TPH, to the "open air" crusher house. The coal is reduced to minus ¾" size in an S-A Knittel crusher that can't clog and that delivers *full capacity* even when handling wet, sodden coal.

From the crusher house, coal goes either to the stocking out conveyor or to the plant. At the storage bunkers a traveling tripper discharges through a "Zipper" bunker seal. This seal opens and closes like a slide fastener through bunker openings directly under tripper spouts, so that no dust can escape.

Coal to be stockpiled travels by a stocking out conveyor and is discharged through a telescoping spout that automatically shuts off flow when the pile reaches a predetermined height. Coal to be reclaimed is returned to track hopper by bulldozer or carry-all.

Corrugated steel hoods over all outside conveyors, and dust curtains at discharge points, effectively keep down dust. For all belts rugged, durable S-A "Simplex" carriers with spun ends and bearings protected by labyrinth seals were specified.

This is an example of the way S-A engineering can meet specific requirements for distribution, volume and clean handling. No matter how specialized your need, you'll find S-A experience and *complete equipment* offer a sound economical solution. Write us whenever we can help you.

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Allpax furnishes these rings with all types of joints in any quantity required. (Butt joint shown here). They can be put in stuffing box without fracturing or breaking. They do not have to be fitted over end of shaft but can be applied the same as any other ring form packing.

Moulded Rings

This packing is made up in die pressed moulded ring form in any size required. Rings are endless and are slipped over end of shaft.

ALSO: Packings in coil, ring (Allpax furnishes rings in all styles of packing), sheet or loose form; Valve Discs; Retainer Packing; Packing Hooks; Gasket Cutters.

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## More PLANT PROBLEMS

Begins on page 132

gerous because the new surfaces absorb oxygen. We find that 3-ft-thick layers of coal can be built up to 15-ft heights without danger.

Be careful when handling bituminous coal because its ignition temperature of 878 F makes it easily ignited by hot steam pipe. We have seen coal dust ignite when it contacted a 650-F steam pipe.

L W FITZPATRICK
*Jefferson City, Mo.*

**MINIMIZE** coal handling as much as possible. Improper handling increases the percentage of fines and makes spontaneous combustion more dangerous. Fire insurance companies say "Break up the risk," that is use smaller piles, if possible. Do not store coal from two different beds in the same pile. Avoid storing fresh coal in a pile containing old coal.

JOHN F DOYLE *New York, N. Y.*

**STUB PIPES** set in the ground and containing thermocouples are practical where it is impossible to drive long pipes from pile surface. While this arrangement may be expensive, it saves money in the long run if many fires are detected.

C A PEYBONNIN, JR
*New Orleans, La.*

**INADEQUATE COMPACTING** causes *NB's* troubles. Air flows into the pile and combines with the coal, producing a hot spot. Compaction by bulldozers and tractors is the most effective means of minimizing air flow through the pile.

Daily temperature checks are necessary for large coal piles. For small piles, a weekly check is usually sufficient. Keep a temperature record of the pile so any increase can be carefully watched.

Hot spots can also be found by observing the coal's appearance under different weather conditions. With a damp atmosphere the hot spots will be dry and lighter in color than the remainder of the pile. During cold weather streams of vapor issue from the burning areas. Gas odors are another indication of a hot spot.

A J BREUGELMANS *New York, N.Y.*

**NYLON CABLE** for holding thermocouples is an excellent solution to locating *NB's* hot spots. This cable is purchased from a firm specializing in this business.

RICK DENNING *New York, N. Y.*

(*Continued on page* 208)

More inches of VISIBILITY . . . and No Blind Spots with NEW Jerguson STEAM GAGES

*Assembly No. 618*

You get more inches of visibility within centers available . . . and no blind spots with the New Jerguson Steam Gages with the horizontal expansion loop. The special new compact valve, with a *horizontal* loop that keeps the strain off the gage assembly under varying conditions of expansion and contraction, gives you maximum gage room within the centers.

The special offset single piece gage chamber design with staggered glasses and covers gives you continous visibility of the water level *with no blind spots* between gage sections.

The gage can be turned at any angle, yet there are no stuffing boxes between gage and valves. The ingenius design of the assembly includes a bracket so the gage will always stay in vertical position. The OS&Y valves have renewable seats and are standard with quick closing stem for chain operation, as shown, or available with plain closing stems and chain wheels.

Made in three designs of single piece chamber: for one, two, or three section glass for any W.S.P. Any Jerguson standard gage may be supplied with stems and flanges for use with this expansion loop valve.

*Write for full information on Jerguson New Steam Gages with Horizontal Expansion Loop Valves.*

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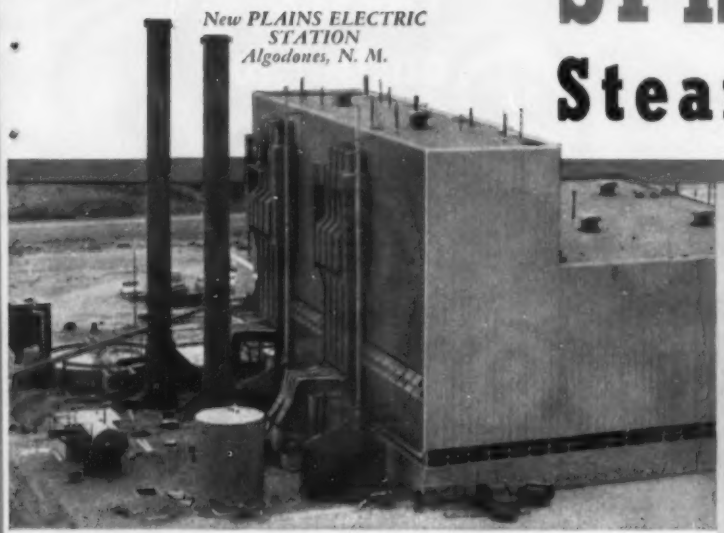
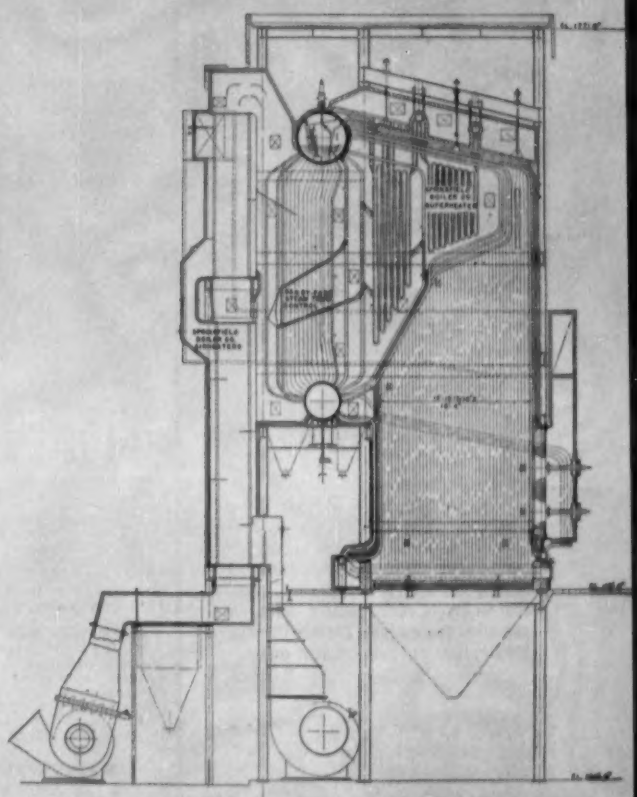
# *Another New Installation of* SPRINGFIELD Steam Generators...



*New PLAINS ELECTRIC STATION Algodones, N. M.*



**2 Units for PLAINS ELECTRIC GENERATING & TRANSMISSION COOPERATIVE, INC.**
Algodones, New Mexico

*"Our project supplies electric energy to eleven of the seventeen distribution cooperatives in the state of New Mexico and to one in southern Colorado,"* writes Norton Davis, Manager, PLAINS ELECTRIC GENERATION AND TRANSMISSION COOPERATIVE, INC. *"This project was built with the primary idea in mind of supplying the much needed, economical electric power in the area served by our member distribution cooperatives. It, therefore, follows that a great deal of study was given to the selection of all major equipment with an eye to economy and reliability of operation."*

Numerous ingenious and advanced features are incorporated in the design of the Springfield Steam Generators furnished for the new Algodones, N. M., plant. In addition to automatic superheater temperature control, provision is made for control of flue gas temperature above dew point in airheater on low loads. The steam washer is of Springfield patented design and all provisions are made for future spreader stoker firing with economizer and dust collector ahead of I.D. fan, if desired. As shown in the above photograph, the generators are placed so that the unit rear walls form a portion of the building wall.

Find out about the broad range of service SPRINGFIELD offers—from small, standardized PACKAGE BOILERS to large, specially designed STEAM GENERATING UNITS. *Your inquiry will receive prompt attention.*

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| Continuous Steam Capacity, Each Unit | 160,000 lb/hr. |
| Maximum Steam Capacity (2-hr. peak) Each Unit | 180,000 lb/hr. |
| Boiler Design Pressure* | 950 psig |
| Operating Pressure, at Superheater Outlet | 875 psig |
| Final Steam Temperature (Controlled) | 910° F. |
| Maximum Heat Release | 29,900 Btu/cf/hr. |
| Heat Recovery: Springfield Two-Section Tubular Airheater. Provisions for future Springfield Steel Tube Economizer. | |
| Type of Firing | Gas and/or Oil (Future coal) |
| Installation | Semi-Outdoor |

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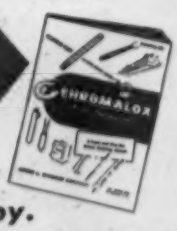


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THE BEST IN ELECTRIC HEAT

## More PLANT PROBLEMS

Begins on page 132

**Other readers** sending good answers on stockpile fires, for which we lacked space, are:

| | |
|---|---|
| C G Howarter | Canton, Ill. |
| E S Monroe, Jr | Ithaca, N. Y. |
| S R Higgins | Long Beach, Calif. |
| O W Palmenberg | Tenafly, N. J. |
| John Davis | Los Angeles, Calif. |

**Ash fusion** *(Cont. from p 136)*

thorities agree that the principal cause of low fusion is iron. The Bureau of Mines, in an early reference, finds the percentage of iron usually increases with the percentage of sulfur.

Other early discussions of this subject verify these findings and show that high iron oxide goes with low fusion temperature.

C Harold Berry *Cambridge, Mass.*

**Other readers** sending good answers on ash fusion, for which we lacked space, are:

| | |
|---|---|
| Paul D Hobson | *State College, Pa.* |
| C G Howarter | *Canton, Ill.* |
| J H Riviere | *Sante Fe, Argentina* |

## More FREE BULLETINS

Begins on page 165

**15** **Office lighting.** Subjects presented include layout and planning, maintenance, quantity of light, fluorescent vs incandescent, light distribution, etc. Illustrated 20-page bulletin. Sylvania Electric Products Inc, 1740 Broadway, New York 19, New York.

**16** **Power line carrier systems** for power utility communications. Manual simplex, automatic simplex and duplex equipment is described as to advantages and uses. Illustrated 12-page technical bulletin E-111. Motorola Communications & Electronic, Inc, 4501 W Augusta Blvd, Chicago 51, Illinois.

### MAINTENANCE EQUIPMENT AND MATERIALS

**17** **Plastic closures,** threaded and non-threaded, for safeguarding fittings, valves, machined parts, etc in process, storage and transit. Descriptions, dimensions, applications, sample plastic *CaPlugs* in illustrated file folder. Protective Closures Co, Inc, 2207 Elmwood Ave, Buffalo 25, N. Y.

**18** **Expanding mandrels** for grinding, milling, inspection, repair and maintenance. Illustrated 4-page bulletin LC 1054. Le Count Tool Works, Inc, 390 Capitol Ave, Hartford, Conn.

**19** **Threaded fasteners.** Photos and text describe socket screw products, square head set screws, pressure plugs, dowel pins and socket screw keys. 32-page bulletin. Standard Pressed Steel Co, Box 577, Jenkintown, Pa.

**20** **Wire rope assemblies.** Photos, diagrams, specs in 22-page catalog 5201, describe eyes, studs, sleeves, hooks and other terminals. Macwhyte Co, Kenosha, Wis.

**21** **Portable power tools.** Photos, specs of electric hammers, drills, saws, screwdrivers, hammer drills, grinders and sanders, and vibrators. 26-page catalog 5416. Syntron Co, 492 Lexington Ave, Homer City, Pa.

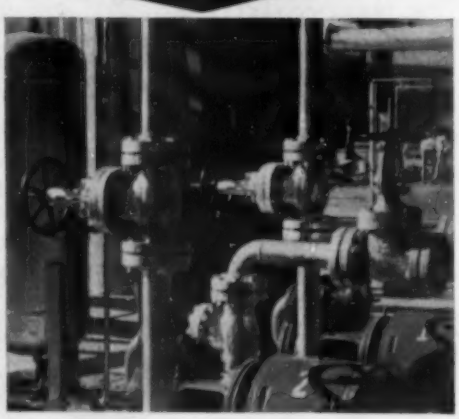
**22** **Cleaning piping systems** with chemicals. Photos, case histories,

WALWORTH VALVES on the job in power plants

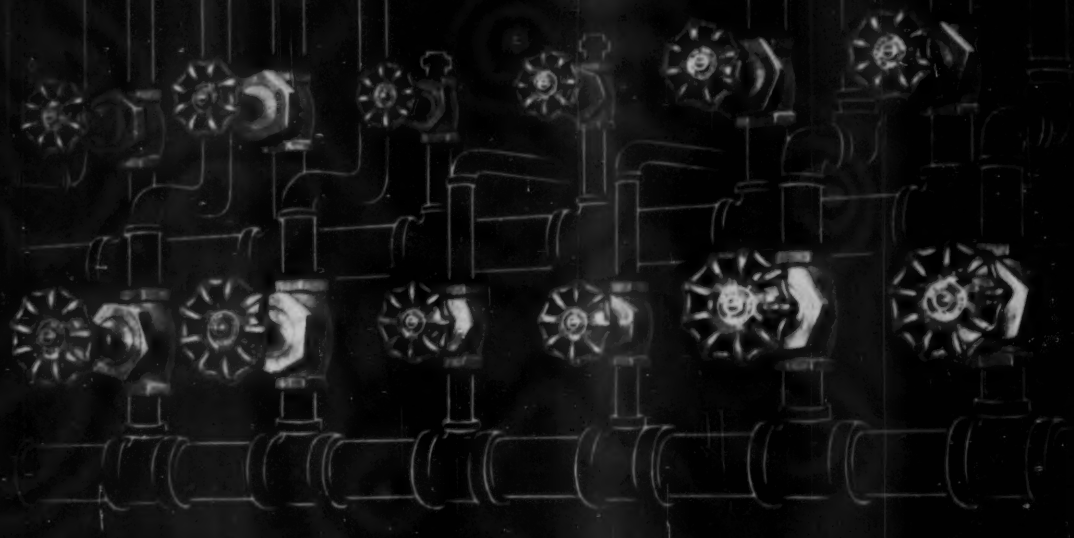
The piping arrangement shown below handles turbine lubricant in a new 15,000 kw thermoelectric plant south of the border*. Walworth products in this modern installation include Cast Steel Pressure-Seal Gate Valves, Cast Steel Bolted Bonnet Gate and Check Valves, and Extra Heavy Iron Body Gate Valves.

Your nearby Walworth Distributor can supply Walworth Valves and Pipe Fittings for modern power plant requirements. For further information see him, contact your local Walworth representative or write: Walworth Company, General Offices, 60 East 42nd Street, New York 17, New York.

*Name on request

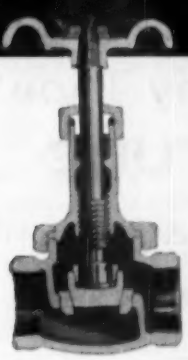


# WALWORTH



## BRONZE VALVES

*Better because* ... **Walworth has standardized its line of bronze valves to provide an unsurpassed system of interchangeability of parts for assembly or replacement. You can maintain a great number of Walworth Bronze Valves with a small inventory of basic parts . . . you minimize part replacement problems. For further information, ask us for our Bronze Valve Standardization Chart.**



**Parts are carefully machined and finished to close tolerances, thereby assuring accurate fit and alignment under all conditions. Sectioned valve is Walworth No. 225P Bronze Globe Valve with stainless steel plug-type seat and disc, heat-treated to a minimum of 500 Brinell hardness.**

Choose from complete lines of Walworth Bronze Valves – including gate, globe, angle, check, and lubricated plug types. Walseal® Bronze Valves and Fittings are also available for making silver-brazed joints.

For full information on Walworth Bronze Valves and Fittings, call your Walworth Distributor, nearest Walworth Sales Office, or write to Walworth Company, General Offices, 60 East 42nd Street, New York 17, N. Y.

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**valves . . . pipe fittings . . . pipe wrenches**

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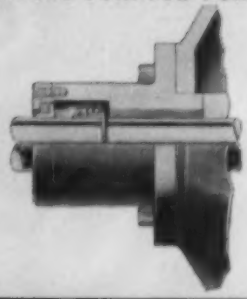
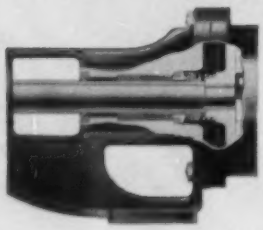


54 HEAVY-DUTY PUMPS



NOW AVAILABLE WITH MECHANICAL SEALS

General Purpose all-weather Viking Pumps in sizes from 20 to 200 G.P.M. and Heavy-Duty Viking pumps in sizes from 10 to 300 G.P.M. can now be furnished with mechanical seals. The seals are packaged units with a minimum of parts and no chance for mis-assembly.

Both types of pumps equipped with mechanical seals also feature carbon graphite bearings requiring no lubrication.

For leak-proof, long-lived service, specify mechanical seal equipped General Purpose or Heavy-Duty Viking pumps.

For additional information ask for folders SP-336W and SP-344W.

## VIKING PUMP COMPANY

CEDAR FALLS, IOWA

THE ORIGINAL "*GEAR-WITHIN-A-GEAR*" ROTARY PUMP

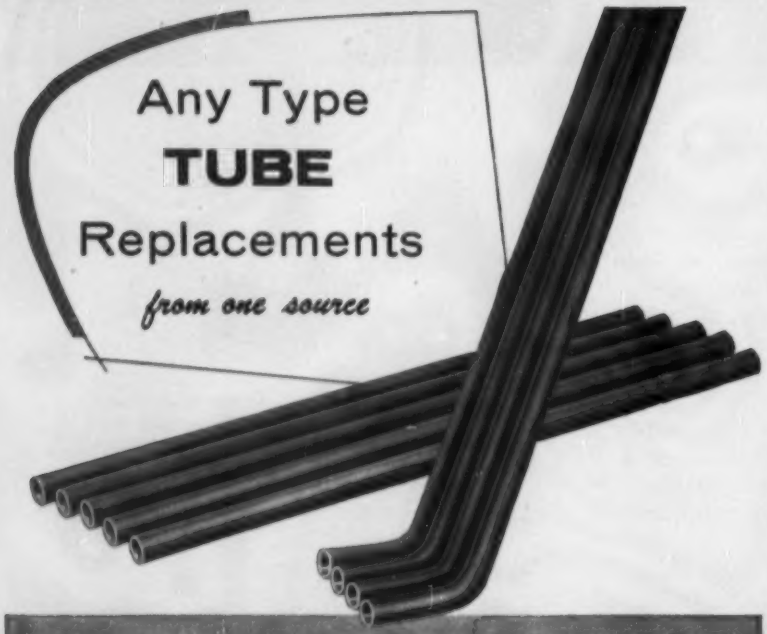


Any Type

**TUBE**

Replacements

*from one source*



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(Pittsburgh District)

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# More FREE BULLETINS

*Begins on page 165*

methods in 4-page bulletin. Dowell Inc, Box 536, Tulsa 1, Oklahoma.

**23** **Ultrasonic fluxless soldering** and metal coating. Applications, photos, equipment data in 10-page bulletin. Aeroprojects Inc, 310 E Rosedale Ave, West Chester, Pa.

**24** **Cork compositions,** structure of natural cork, granulated cork and cork flour described in 4-page bulletin. Uses include gaskets and seals, sleeves, plugs, clutch and brake facings. Dodge Cork Co, Inc, Lancaster 21, Pa.

### MECHANICAL TRANSMISSION

**25** **Roller gear drives.** Applications, selection procedures, nomenclature, load requirements, and complete specs in 22-page bulletin 105. Ferguson Machine & Tool Co, Inc, Box 191, St Louis 21, Mo.

**26** **Power transmission equipment.** Complete line of single and multiple groove and variable pitch sheaves, V-belts, couplings, pulleys, chain sprockets, roller chain, etc, described in illustrated 20-page catalog GC-101-B. Browning Manufacturing Co, Maysville, Kentucky.

**27** **Clutches** and clutch - coupling units. Photos, application drawings, engr data, specs in 20-page catalog 102. Formsprag Co, 23601 Hoover Rd, Van Dyke, Mich.

★ **Fluid couplings** for use on equipment powered by any type electric motor or internal combustion engine from ¾ to 850 hp. Photos, diagrams, drawings in 14-page bulletin 144-D. ★Request direct from Twin Disc Clutch Co, Dept DS, Racine, Wisconsin.

**28** **Air clutch** for operation at pressures to 150 psi. Photos, features, specs in 4-page bulletin A-634. Dodge Manufacturing Corp, Mishawaka, Ind.

**29** **Speed variator** provides speed regulation from 1/3 to 3 times the input speed—9 to 1 total variation. Photo, cutaway, advantages in 4-page bulletin K-100. The Cleveland Worm & Gear Co, 3269 E 80th St, Cleveland 4, Ohio.

**30** **Cam clutches** for indexing, overrunning and backstop applications. Reference file includes 8-page catalog and 4 catalog sheets. Cutaways, operating functions, specs. Morse Chain Co, 7601 Central Ave, Detroit 10, Mich.

**31** **Crown couplings.** Photos, selection data, advantages, specs in 4-page bulletin 2203. De Laval Steam Turbine Co, Trenton 2, New Jersey.

### METERS AND INSTRUMENTS

**32** **Receiver recorder** for pneumatic and electric transmission systems. Photos, application, operation, engineering data, specs in 12-page bulletin E12-5. Bailey Meter Co, 1050 Ivanhoe Road, Cleveland 10, Ohio.

**33** **Recording-controller** for electric two-position or pulse-proportional control. Two-page bulletin 62. Thermo Electric Co, Inc, Saddle River Township, Rochelle Park Post Office, New Jersey.

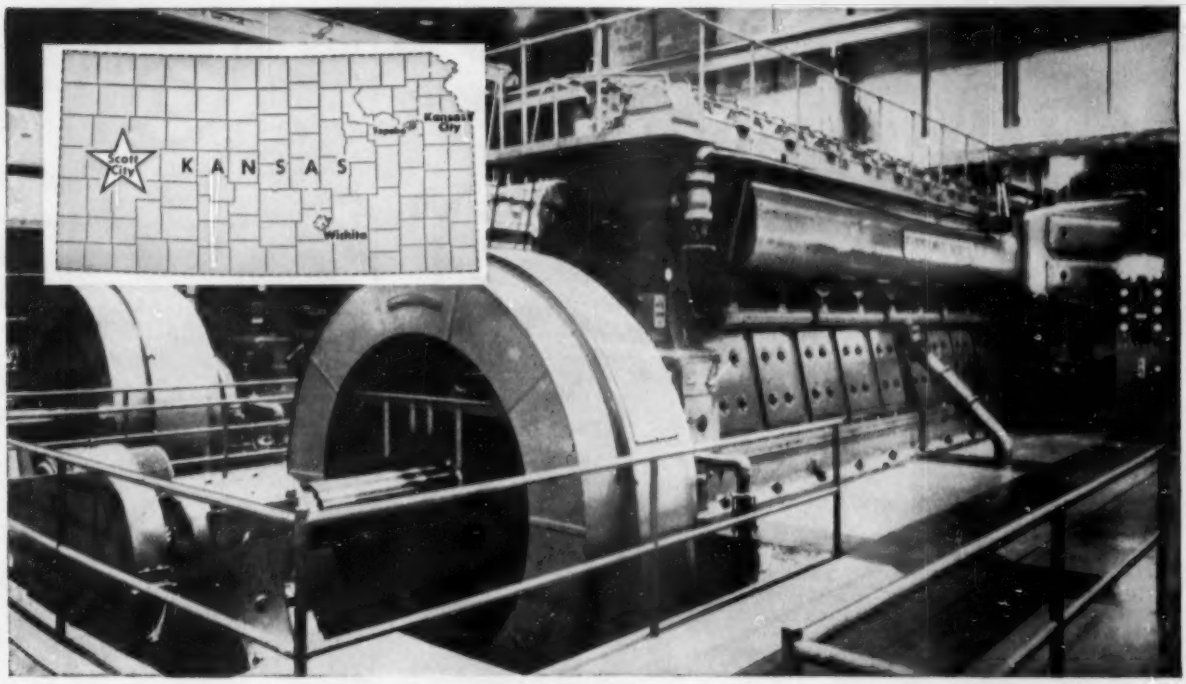
**34** **Draft gage,** diaphragm operated. Can also be used for remote indication of pressure, flow, level, temperature, etc. Four-page bulletin 54-1060-210. The Hays Corp, Michigan City, Indiana.

**35** **Combustible gas analyzers.** Explosion-proof, continuous units. Photos, diagrams, description of components, typical installations in 20-page bulletin 0703-3. Mine Safety Appliances Co, 201 N Braddock Ave, Pittsburgh, Pa.

### PIPING, VALVES, FITTINGS

**36** **Plastic pipe,** fittings and valves. Complete specs, dimensions in 6-page bulletin 80-A. American Hard Rubber Co, 93 Worth St, New York 13, New York.

(*Continued on page 212*)

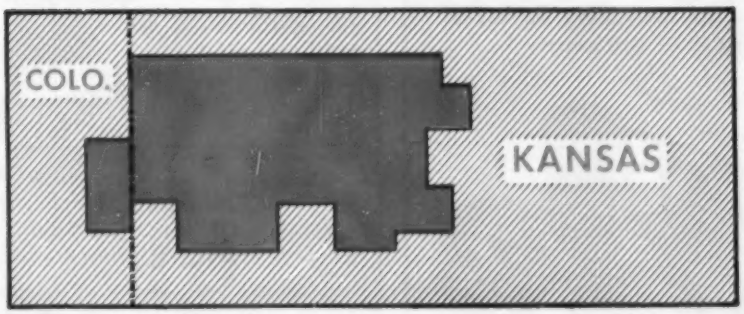



# Largest REA Plant in Kansas Reports Cities Service DC-840 Diesel Oil Excellent!

Fairbanks-Morse Diesels of Wheatland Electric Cooperative, Inc. give outstanding performance using DC-840 Oil for power cylinder and crankcase lubrication. Here are the results Wheatland achieved:

1. House operation each unit—13,000 hours.
2. No oil changes due to oil failure.
3. No overhaul or major breakdown.
4. Rings free in groove with little or no signs of wear.
5. Oil consumption within mfgr's. recommendation.
6. Fuel consumption 10,572 BTU/KWH, load factor 63.7%.
7. Maintenance of lubricating oil at minimum expense.
8. 3500 H.P. hours per gallon of lubricating oil.
9. No wear on main or rod bearings.
10. No oil change at end of 9,000 hours.

For similar results in your Diesel operation, contact your nearest Cities Service office or write to Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.




WHEATLAND ELECTRIC COOPERATIVE, INC. serves 3,300 square miles in all or part of Scott, Wichita, Hamilton, Greeley, Kearny, Wallace, Logan and Finney Counties in Kansas as well as sections of Kiowa and Prowers Counties in neighboring Colorado. Also supplies wholesale the Lane-Scott Cooperative serving 2,200 square miles in 6 Kansas Counties.

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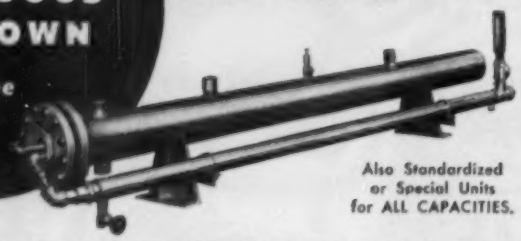
HENSZEY
CONTINUOUS
BLOWDOWN
packet-type

**complete, automatic control of boiler water concentration**



Also Standardized or Special Units for ALL CAPACITIES.

**PREVENTS PRIMING**
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**PREVENTS SLUDGE**
**PREVENTS SCALE**
(with simple chemical treatment)

This compact self-contained unit is completely assembled. Can be installed by your own men in hours. It provides completely automatic control of boiler water concentration regardless of variations in boiler load. This is accomplished WITHOUT HEAT LOSS. Maintain clean efficient boilers for substantial savings in fuel, equipment and manpower.

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DEPT. D1 • WATERTOWN, WISCONSIN

Continuous Blowdown and Boiler Plant Specialties • Boiler Feed Regulators • Distillation Systems • Heat Exchangers • Feed Water Meters • Flow Indicators • Proportioning Valves
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**THIS DROP OF OIL**
IS GOOD FOR MOST MACHINERY

*but . . .* it is bad in the food you eat, the beverages you drink and disastrous in some chemical processing when it leaves the machine and gets into your product.

That's why more people like you are buying our OILFREAIR and OILFREGAS Compressors guaranteed to compress air and gas entirely free of any trace of oil or oily vapor.

**It's a fact you cannot effectively separate oil vapor from compressed air and that's why the only sure cure for contamination is to prevent it at the source.**

Bulletin 600-3, yours for the asking, describes these compressors.
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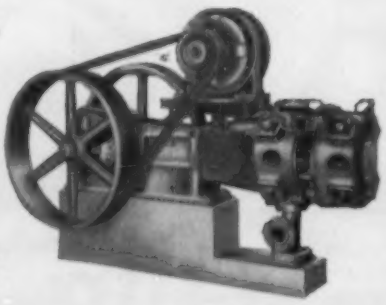



## More FREE BULLETINS

Begins on page 165

**37** **Relief valve** capacity bulletin. Selection data for determining proper valves for hot water supply systems, space heating or supply boilers. Eight-page bulletin 1. Watts Regulator Co, Lawrence, Massachusetts.

**38** **Globe valves,** sizes ¼ through 2 in. for high vacuum to 4000 psig at 1000 F. Diagrams, specs in 16-page bulletin Section B. Associated Valve & Engineering Co, 1150 W Marquette Rd, Chicago 21, Illinois.

**39** **Pressure regulators** for steam heating and process applications. Photos, full specs in 8-page bulletin F-127-544. Watts Regulator Co, Lawrence, Massachusetts.

**40** **Steam and air traps** for pressures to 600 psig. Photos, specs, capacities in 4-page bulletin 5415. The C E Squires Co, 18502 Syracuse Ave, Cleveland 10, Ohio.

**41** **Piping, trapping** and venting steam and hot water unit heaters. Photos, diagrams, installation instructions in bulletin 15. Industrial Unit Heater Association, 2159 Guardian Building, Detroit 26, Michigan.

**42** **Wrought iron pipe.** Specs, dimensions in single-page data sheet. A M Byers Co, Pittsburgh, Pennsylvania.

### PRIME MOVERS AND ACCESSORIES

**43** **Diesel engines** from 4500 to 10,800 hp, stationary and marine. Photos, features, typical installations in 12-page bulletin 235. Nordberg Manufacturing Co, Milwaukee 1, Wisconsin.

**44** **Industrial engines,** 225 to 675 hp. Photos, cutaways, applications, specs in 8-page bulletin E-7. Le Roi Div, Westinghouse Air Brake Co, 1706 S 68th St, Milwaukee 14, Wisconsin.

**45** **Engine-generator sets,** 60 to 675 hp units, producing from 50 to 350 kw. Photos, dimensions, accessories in 8-page bulletin G-6. Le Roi div, Westinghouse Air Brake Co, 1706 S 68th St, Milwaukee 14, Wis.

### MISCELLANEOUS

**46** **Cyclone** for slurry thickening clarification, classification and recovery of suspended solids. Photos, applications, specs in 16-page bulletin. Heyl & Patterson Inc, 55 Fort Pitt Blvd, Pittsburgh 22, Pennsylvania.

**47** **Pumps,** circulating and coolant. Photos, dimensions, performance curves, cutaways in 20-page bulletin 7074-D. Ingersoll-Rand Co, 11 Broadway, New York 4, N. Y.

**48** **Cork insulations** for pipe covering, lagging, low temperature applications. Illustrated 4-page bulletin. United Cork Companies, Dept 1-19, Kearny, N. J.

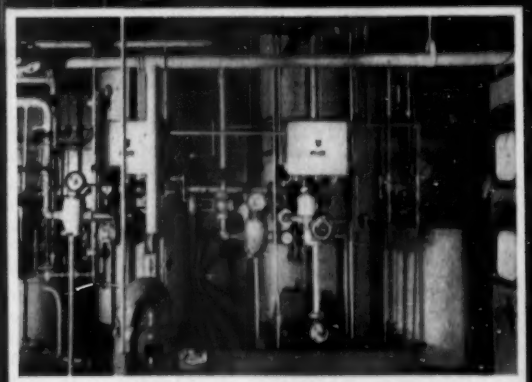
**49** **Fluid power equipment.** Pumps, motors, transmissions, cylinders, valves and accessories described in 12-page bulletin 10051-D. The Oilgear Co, Milwaukee 4, Wisconsin.

**50** **Glass blocks** for toplighting buildings. Photos, charts, installation data, specs in 8-page bulletin *Skytrol*. Pittsburgh Corning Corp, One Gateway Center, Pittsburgh 22, Pa.

## Modernization Awards

To learn how you can win recognition for your accomplishments, see pp 80-81.

FOR IOWA SOUTHERN'S NEW $10,000,000 BRIDGEPORT STATION



*Automatic Permutit Demineralizers produce low-solids, low-silica make-up*

**ENGINEERING by Pioneer Service and Engineering Company, Chicago, Illinois**

# *Water by* PERMUTIT®

Pioneer chose Permutit Demineralizers to protect Bridgeport's high-pressure boilers from raw Des Moines River water with its total hardness of up to 426 ppm, high silica of up to 11 ppm.

As a result, Bridgeport Station's make-up is far better than most distilled water, yet costs far less. Total solids are reduced to 0-4 ppm. Surfaces stay scale-free for high heat-transfer. Silica is reduced to 0.045 ppm and lower . . . preventing deposits on turbine blades, costly shutdowns.

**Permutit Demineralizers** operate automatically . . . deliver full capacity even when turbines are running light. A Permutit Precipitator and Filters first clarify the muddy river water for the Demineralizers. This clarified water also supplies the 400,000 gallon cooling-tower basin.

Consider the advantages of getting the equipment for *all* types of water treatment from one source . . . and you'll bring your water problems to Permutit.

**Write for technical information.** The Permutit Company, Dept. P-1, 330 West 42nd Street, New York 36, N. Y., or Permutit Company of Canada, Ltd., 6975 Jeanne Mance Street, Montreal.

WATER CONDITIONING HEADQUARTERS

PERMUTIT®

# Improved Quality of Plant Water Results in Lower Production Costs and Up Grading of the Product

Depleted water supplies and a consequent degenerating quality of water has caused much concern in industry. Dirty water causes increased maintenance costs and reduces the quality of many products.

The low initial cost of diatomite filters combined with their low floor space requirement and ease of operation have proved very attractive to industry. The diatomite filter will remove all silica sand, algae, organic matter and silt from water sources such as wells, rivers, or lakes. Bacteria is reduced 80% or even more in some cases. The quality of filtered water is always constant, no deterioration or variation is encountered. Add to the above that one filter can be cleaned with the output of a second filter, which eliminates the need for oversize pumps or large holding tanks for filtered water, and the reasons for the interest in diatomite filters are quite apparent.

**Some examples of recent applications are:**

One firm's problem was the breakage of their welding tips. The welding tips would become burned, turn brittle, and then break. Dirt in the cooling water was suspected, and Sparkler diatomite filters were put on the job. The life of the welding tips was extended eight to ten times by the use of filtered water.

Another firm has produced an off-white chemical for many years. Their source of water is a highly colored river which is heavily contaminated with industrial wastes. Sand filters had been installed for many years. When it was decided to improve the product's color, two 400 sq. ft. Sparkler diatomite filters were installed. The installation was designed to clean one filter with the output of the other. This firm now produces a true-white chemical and have been rewarded by an increased demand for their product.

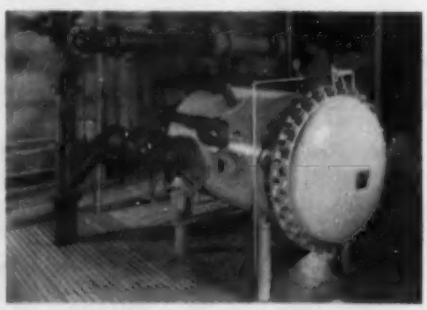
A third firm obtains their water from deep wells. It contains large amounts of very fine sand. This sand caused excessive wear in high head pumps and clogged fine fog nozzles interrupting production and increasing maintenance costs. Sparkler diatomite filters were installed on this four million gallon a day application and completely removed the above troubles.

In all of the above applications, it is apparent that an improved quality of plant water resulted in lower operating costs and improved products.

The Sparkler Model SCJ diatomite filter is designed specifically for large volume water filtration. Available in sizes up to 2000 sq. ft. of filtering surface with capacities up to 5,000,000 gal. per day in a single unit. Multiple units engineered for larger requirements.

The original cost of a Sparkler diatomite filter is about ⅔ that of a sand filter and the floor space required less than ½.

Write Mr. Don Baldwin for engineering service and estimate on your requirements.



Crystal clear water is obtained from a pond for plant use at Trent Tube Co. with this Sparkler Model SCJ diatomite filter. Flow rate 1,152,000 gallons per 24 hr. day operation from this single filter unit.

**SPARKLER MFG. COMPANY**

Mundelein, Illinois

Sparkler International Ltd.
Plants at: Galt, Ontario, Canada
Amsterdam, Holland

Sparkler Manufacturing Co., Mundelein, Illinois

☐ Have engineering representative call for consultation on our water problem. ☐ Mail plant water filtering bulletin.

*Company*_____

*Address*_____

*Individual to contact*_____


## More TECHNICAL BRIEFS

Begins on page 152

### Electricity

**A new design concept for d-c motors.** *By William R Hough and R A Geuder, Reliance Electric and Engineering Co.*

The need for more useful power in all industry has grown year by year. Synchronized drive systems have long been common in the metal-working industries. With the advance in the art, the useful power—the synchronized drive—has been asked to do more and more to help produce speeds, accuracy and precision necessary to satisfy the many other complex requirements that yesterday were obtainable only in the laboratory and today are regarded as commonplace in the plant.

Motors that power metal-forming and processing machinery, machine tools, presses, conveyors, shears, and an endless variety of production tools must meet demands for fast acceleration and deceleration, smooth, shockless starting, stopping, and reversals, and split-second timing, with hairline accuracy and unfailing dependability. In addition, modern machinery is being influenced more and more by the needs of automation, which means that production is directly influenced by the rate of speed change —dynamic response—rather than by mere responses themselves. With needs growing constantly, yesterday's design luxury becomes today's necessity.

A new concept has grown to meet these needs—new direct-current motors—that with their control can and will produce the required dynamic response. This new concept, like all new things, has grown from experience influenced by needs of industry. First the armature-shifting motor, then the field-control motor with new and better interpole design, and packaged adjustable speed drives carried the art of direct-current use a step further. And now, after almost fifty years, a truly new design concept for d-c machinery, dynamic response. High commutating ability, low electrical time constants, low mechanical inertia and know-how born of experience and research will produce d-c motors that will fill tomorrow's needs. *AISE paper; no number.*

**Operation of magnetic amplifier controlled tandem mills.** *By J W Brinks, Westinghouse Electric Corp, and J C Peth, Pittsburgh Steel Co.*

Anyone associated with the iron and steel industry knows that when steel-mill equipment is purchased it almost invariably represents the most modern available to perform the function for which it has been purchased. Empha-

Directions for ordering papers on p 218

# Guaranteed TO SHUT TIGHT*

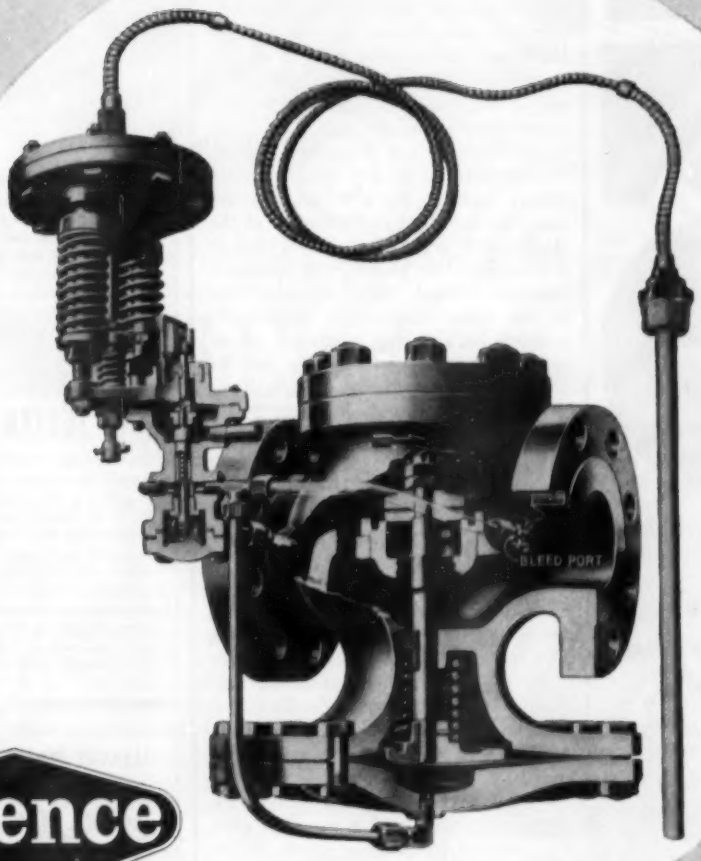
* When equipped with a SECO Metal Seat and Disc on steam service and protected by an approved Strainer, a Spence Regulator is guaranteed to shut tight when the demand for steam ceases.

Expensive steam leaks due to a lack of absolutely tight shutoff are eliminated in Spence Temperature Regulators. Here is why we can make such a guarantee:

First, our temperature regulators are of the single seat design. Seats and discs are made of durable SECO Metal. More than 20 years experience in thousands of installations has failed to produce a single case where SECO Metal has been cut by steam.

These plus other design features explain why Spence Temperature Regulators function dependably and accurately year after year without requiring expensive repairs or special attention.

Want more facts? Write for Bulletin T50 giving full details.




SPENCE
TYPE ET150
Temperature
Regulator

Spence

**SPENCE ENGINEERING COMPANY, INC.**
**WALDEN, NEW YORK**

88 180

*talk to the man*

... who has all the answers on the plant maintenance and engineering product, service, supply or machine you need to keep your plant running at top speed.

In fact, talk to the thousands of technical experts who will be on hand to welcome you to more than 400 exhibits.

There's no other way to get so *much* information, so *many* new ideas. Find out direct from the men who know, all about the products that can save your plant money and time.

The four days you spend at the Show, and at the all-important Plant Maintenance and Engineering Conference, are *on-the-job* days that will payoff in increased plant efficiency. Mail the coupon today for Show tickets, and conference information.

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**6th National Plant Maintenance & Engineering Show & Conference**

**International Amphitheatre, Chicago**
**January 24-27, 1955**

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Please send me free tickets for the 6th National Plant Maintenance & Engineering Show and information on the Conference.

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# More TECHNICAL BRIEFS

Begins on page 152

sizing this is the increased use of magnetic amplifiers on suitable regulating-system applications. Perhaps the most notable of the new applications of magnetic amplifiers is their use as the complete generator regulation and excitation components of tandem cold-strip mill control.

Early this year, a 66-in. wide four-stand tandem mill was put into service at the Allenport plant of Pittsburgh Steel Co. The mill, having a nominal delivery speed of 3190 fpm, has a total stand and reel connected horsepower of 17,700. Individual generators supply power to each stand and reel.

Voltage of each stand generator is matched to a common reference bus through a 400-cycle magnetic-amplifier voltage regulating system. Any difference between generator and reference voltages will cause a corrective signal in control winding of the regulator. An IR drop magnetic amplifier introduces a compensating signal into the control circuit to compensate for stand motor IR drop. The general scheme of reel control is similar to that using rotating regulators except magnetic amplifier components are used.

The ordinary run of magnetic amplifier applications utilizes a 60-cycle, a-c supply system. But the fast response and high accuracy requirements of the tandem-mill regulating system led to development of a 400-cycle magnetic amplifier control. Since response time of the magnetic amplifier is inversely proportional to supply frequency, advantage of the 400-cycle system can be readily appreciated.

A second four-stand tandem mill with complete magnetic-amplifier control is expected to begin operation late in 1954 in eastern Pennsylvania, and a third in Ohio sometime in 1955. *AISE paper; no number.*

## Boilers

**Pulsation-induced vibration in utility steam-generation units.** *By R C Baird, The Fluor Corporation, Ltd.*

Severe noise and vibration was encountered by a southwest Pacific power company. Vibration caused much structural damage to boiler ducts, while noise introduced an operator morale problem.

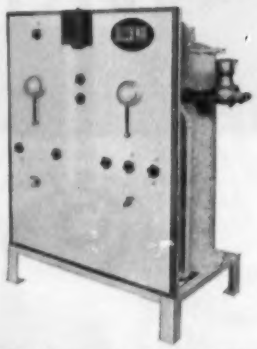
Electronic measurements located the source of trouble and a complete cure was effected by placing simple baffles in the hot gas stream. A theory was formulated showing what factors combined to produce the problem.

The theory indicates that the trend toward larger utility boilers is increas-

*Directions for ordering papers on p 218*

ILLCO-WAY
ionXchange

"PACKAGE-UNIT"
DE-IONIZER



Here, in one assembly, with gray lacquered panel, main and auxiliary valves, and all accessories — is a complete De-Ionizing installation that can be set down *at a unit* anywhere in your plant. Two-Bed and Mixed-Bed models are available for various specifications of effluent, in standard designs, with capacities ranging from 150 to 1,000 gallons per hour.

COMPLETELY ASSEMBLED AND TESTED AT FACTORY

Standardized ILLCO-WAY "Package-Unit" De-Ionizers are completely put together at the factory, including assembly of all piping and valves, attachment of accessories, and placing of ionXchange minerals in the tanks. Each is thoroughly tested, then crated and shipped as a *fully-assembled, ready-to-operate unit* requiring a minimum of installation time. For complete details of these efficient, compact, and time-proved Units, write for a copy of our *Bulletin PK-154.*

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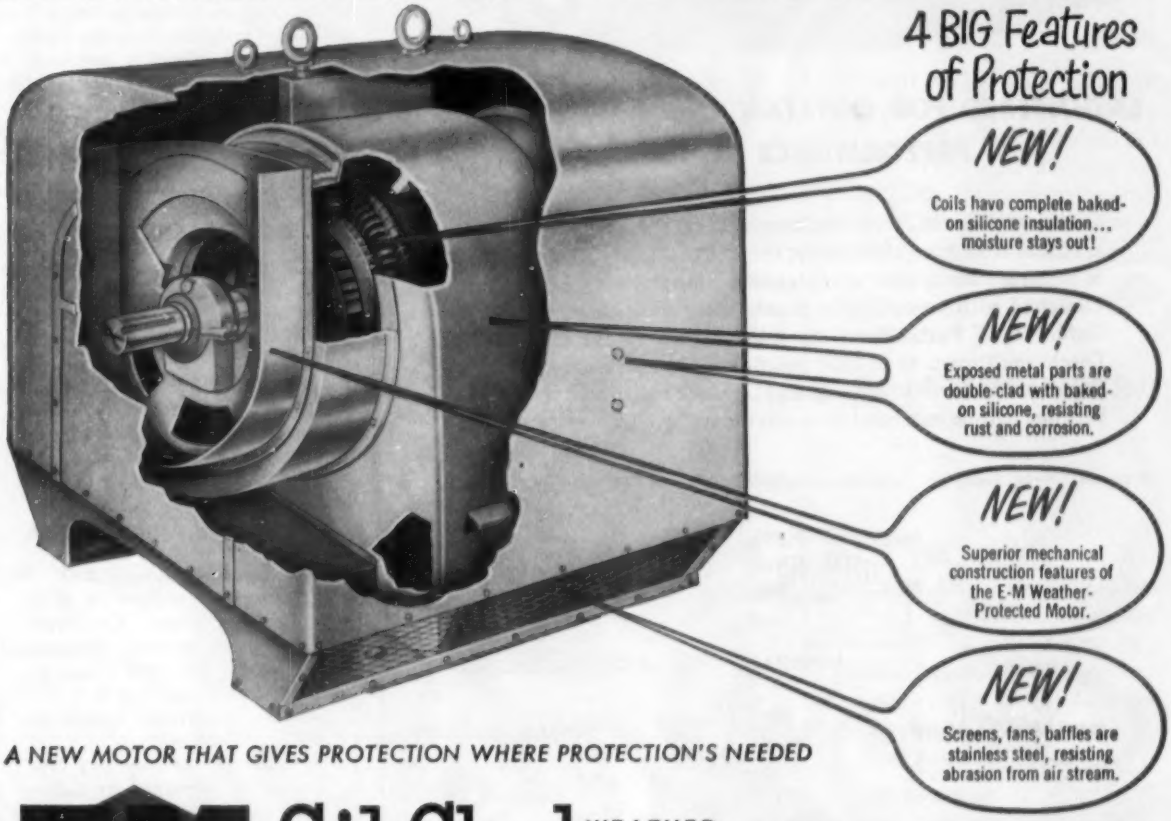
# New E-M Silicone-Protected Motor

## REPELS WATER AND RESISTS CORROSION, INSIDE AND OUT


4 BIG Features of Protection
NEW!
Coils have complete baked-on silicone insulation... moisture stays out!
NEW!
Exposed metal parts are double-clad with baked-on silicone, resisting rust and corrosion.
NEW!
Superior mechanical construction features of the E-M Weather-Protected Motor.
NEW!
Screens, fans, baffles are stainless steel, resisting abrasion from air stream.

*A NEW MOTOR THAT GIVES PROTECTION WHERE PROTECTION'S NEEDED*

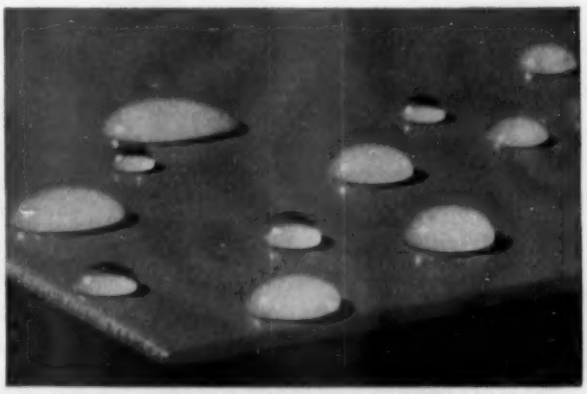
## E-M Sil-Clad WEATHER-PROTECTED INDUCTION MOTOR

(250 hp and larger)

● Here's important news for engineers who would like to specify outdoor motors to minimize building costs at power stations, chemical plants, refineries, pipe lines, pulp and paper mills, smelters, seacoast industries, etc., but who have hesitated to do so because of adverse atmospheric conditions.

The important news is the E-M *Sil-Clad* Motor. It repels moisture penetration in wet, humid or steamy atmospheres. It resists corrosion from chemical fumes or salt air atmospheres. It resists oxidation from sun. In short, the complete silicone protection you get in *Sil-Clad* makes it possible for you to plan outdoor drives at a lower cost under conditions heretofore believed practicable only with the more expensive and not wholly protective totally-enclosed fan-cooled motors.

Get acquainted with the new *Sil-Clad* Motor now. In many cases it can substitute for outdoor totally-enclosed motors. *And Sil-Clad protection is offered on other E-M Motors too!* Ask your nearest E-M sales engineer for the complete *Sil-Clad* story . . . and write the factory for new Bulletin No. 217 which tells how the "wonder" properties of silicone are applied to full advantage in the great new *Sil-Clad* Motor.



**SILICONE METAL PROTECTION REPELS WATER.** See how the droplets of water pull away from the baked-on silicone coating. Coils and winding are silicone-protected, too, in the E-M *Sil-Clad* Motor.

**ELECTRIC MACHINERY MFG. COMPANY**
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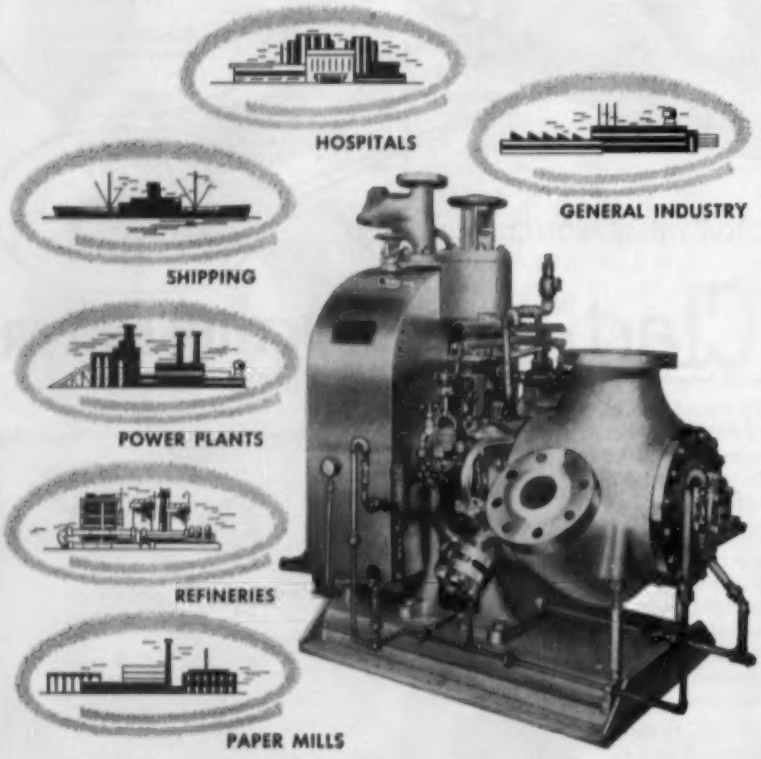
Engineers! Write today for complete specifications. Ask for "DE" Bulletin G-110.

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## More TECHNICAL BRIEFS

Begins on page 152

ing the likelihood of high-intensity gas pulsations that, in turn, may produce severe vibration and noise. Watching proportions of certain factors will end pulsation problems in larger boilers.

In general, vibration and noise appear to result from gas-flow instability along heat-exchanger tubes and an acoustically-resonant duct exchanger housing. *APC paper; no number.*

### TO OBTAIN COMPLETE TEXT

*Material for these abstracts comes from the following sources unless otherwise stated. Order complete paper from source, not* POWER.

*National Research Council of Canada. Identified by initials NRCC and obtainable through purchase from NRCC, div of mechanical engineering, Ottawa 2, Canada.*

*Society of Automotive Engineers. Identified by initials SAE and obtainable through SAE, 29 W 39th St, New York 18, N. Y.*

*American Power Conference, 16th annual meeting. Identified by initials APC and obtainable through purchase from R A Budenholzer, chairman, Illinois Institute of Technology.*

*Association of Iron and Steel Engineers. Identified by initials AISE and to be published in their entirety by AISE, Empire Building, Pittsburgh, Pennsylvania.*

**Proceedings of the** symposium on automatic production of electronic equipment held last April 19-20 in San Francisco, have been published by Stanford Research Institute. The 119-page bound volume contains 17 papers and illustrations relating to automation, product design, construction techniques, materials, components and design of automatic production lines. Proceedings may be obtained for $4.00 a copy by writing Public Relations Office, Stanford Research Institute, Stanford, California.

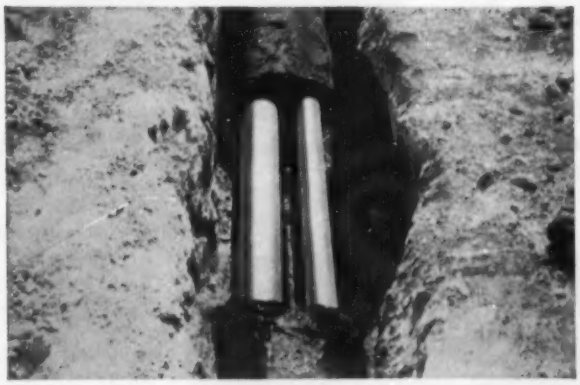
**Dr Maria Telkes,** physical chemist in the research division of the College of Engineering of New York University and widely known authority on solar energy utilization, has been named a consultant to Stanford Research Institute.

**Pacific Gas and Electric Co** plans to install sea water evaporators to produce fresh water for boiler operations in its $44-million 300,000-kw steam-electric generating plant under construction at Morro Bay, Calif. Company officials believe it will be the first industrial application of ocean water distillation in the nation.

# 3 Big Reasons Why

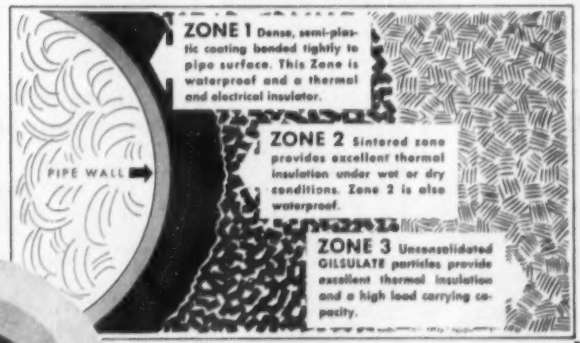
**1. GILSULATE—Easy to install**—Just pour it on, tamp it down and backfill. Run heat through the pipes (up to 520°F)...and the job is completed. No need to remove rocks from backfill; no problems of cramped space or multiple piping.

## more and more hot underground pipe gets insulated



**2. GILSULATE—Cost Less per Installed Linear Foot**—No skilled labor needed...requires no mechanical sheaths, special protective devices, or costly installation procedures.

## with new modern triple-zone GILSULATE®


ZONE 1 Dense, semi-plastic coating bonded tightly to pipe surface. This Zone is waterproof and a thermal and electrical insulator.
ZONE 2 Sintered zone provides excellent thermal insulation under wet or dry conditions. Zone 2 is also waterproof.
ZONE 3 Unconsolidated GILSULATE particles provide excellent thermal insulation and a high load carrying capacity.
PIPE WALL

**3. GILSULATE—Delivers Permanent Triple-Zone Protection**—Three tough, massive circular sheaths completely and permanently protect the pipe, cut heat loss down to 8% to 11% of bare buried pipe. Triple-zone protects against all buried line corrosion conditions: water, roots, acid, alkalis, bacteria, etc.

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Guard holds Flare Roll back—desirable for rolling Tubes closely spaced in thin Tube Sheets.

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# More POWER NEWS

Begins on page 150

**Generator units (continued)**

however, will not be rated to operate at maximum permissable temperature. Sufficient gas pressure will be recommended to maintain a safe margin below the allowable temperature.

It may be concluded from these tests that pressure can be reduced under normal requirements to get greatest economy. Under sudden or prolonged overloads, pressure can be readily increased to preserve any desired safe temperature margin. Relatively small gas content of the fully supercharged machine makes adding or removing gas quick and inexpensive.

**Reduced physical size** of both rotor and stator is one of benefits of supercharging. In addition to new installations, supercharged generators will find application as replacements for obsolete units where larger capacity is required but where space is lacking for plant enlargement.

High reactance of these units will cut switchgear costs while reducing electrical and mechanical injury should a fault occur. Reason: High saturation increases steady-state stability.

**Hydroelectric power (continued)**

powerhouse is estimated to be over $10 million. Present plans call for construction to start in the spring, if appropriate license applied for is issued by the Federal Power Commission.

By a recent agreement with Tennessee Valley Authority, the new Chilhowee plant will be placed under the same operational control by TVA as has been established over the company's other plants on the Little Tennessee and Cheoah Rivers.

## Efficiency increased on battery that converts sunlight to power

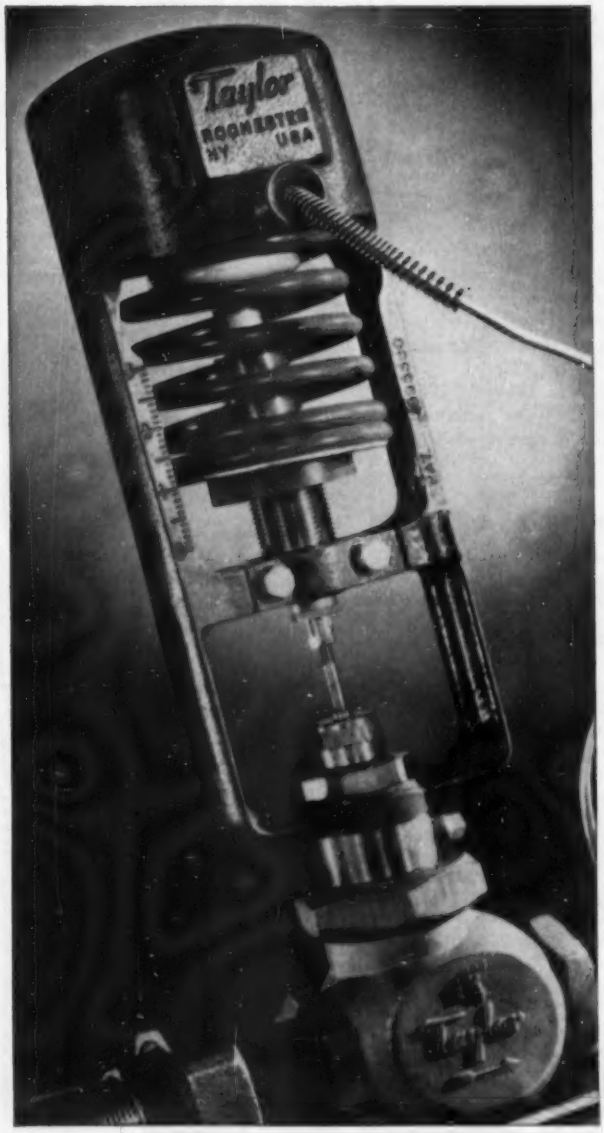
► A ONE-THIRD increase in efficiency of the Bell solar battery—first successful device to convert the sun's energy directly into useful amounts of electricity —has been revealed by Bell Telephone Laboratories. Experimental cells have been built that yield a record 8% efficiency. These efficiencies are comparable to those of steam and gasoline engines.

The Bell solar battery is composed of wafers of specially prepared silicon. One of the world's most abundant elements, silicon is a semiconductor, extremely sensitive to light. The improved cells can be electrically linked together to deliver power from the sun at the rate of 80 watts per sq yd of surface.

Increased efficiency was made possible through elimination, in part, of the

# Don't let us sell you a Fulscope® Controller...

## *for applications where the Taylor Self-Acting Temperature Controller will do the job!*




OUR enterprising management would like us to sell more FULSCOPE Controllers. It's a bigger sale. But your Taylor Field Engineer will tell you that there are many applications where the simple, dependable Self-Acting Temperature Controller will do the job to everyone's satisfaction.

Typical of the jobs that this reliable controller will take in its stride are: hot water tanks; diesel engine water jackets; compressor water jackets; lubricating oil coolers.

It requires no auxiliary air supply for its operation. Double-seated valves are available in sizes up to 2″; single-seated composition disc types up to 1″. There are numerous standard temperature ranges between 10 and 340° F., and semi-standard ranges within limits of 135 and 610° F.

Write for Catalog 36R, or ask your Taylor Field Engineer to tell you about this and other instruments particularly adaptable for the power industry. Taylor Instrument Companies, Rochester, New York, and Toronto, Canada. *Instruments for indicating, recording and controlling temperature, pressure, flow, liquid level, speed, density, load and humidity.*

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**ACCURACY FIRST**
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**A TYPE FOR EVERY USE!**
FOR ALL PRESSURES!
FOR ALL TEMPERATURES!

**Standard & Double Extra Heavy UNIONS**

Available with screwed or socket weld ends. 3000-lb. sizes ⅛" to 3"; 6000-lb. sizes ⅛" to 2".

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With screwed or socket weld ends. 3000-lb. and 6000-lb. service.

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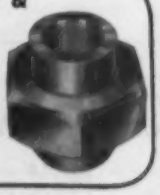
With steel-to-steel, bronze-to-steel, stainless steel-to-steel or orifice seats. 3000-lb. service only.

**FULL STAINLESS & FULL ALLOY STEEL UNIONS**

With screwed or socket weld ends. 3000-lb. and 8000-lb. service.



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## More POWER NEWS

Begins on page 150

radiant energy lost by reflection from the silicon surface and electrical energy lost within the cell itself.

The new battery is expected to find use in the communication field where power requirements are small. Research indicates that the units could be used as power amplifier stations on telephone lines.

### POWER'S History

POWER was founded in 1884 by E P Harris and H M Swetland. With it was incorporated *Steam*, which had been started by N Hawkins in Chicago two years earlier.

In 1903 POWER purchased and absorbed *Science and Industry*, which was a consolidation of a number of periodicals, namely, *Home Study Magazine, Home Study for Machinists, Mechanic's Magazine, Home Study for Building Trades, Building Trade's Magazine, Home Study for Electrical Workers* and *Steam Electric Magazine*.

In 1908 POWER absorbed *The Engineer's Review*, of Cleveland, and *The Engineer*, of Chicago, the latter being a consolidation of *The Safety Valve, Lord's Power and Machinery Magazine, The Stationary Engineer, Steam Engineering* and *The Mechanical Engineer*. When *The Engineer* was purchased, the name of the combined magazine was *Power and the Engineer*. The title was condensed to POWER in 1911. In 1951, POWER absorbed *Operating Engineer*.

All rights to above titles reserved.

### Calendar of Events

**Jan 17-19—American Institute of Electrical Engineers,** high frequency measurement conference. Hotel Statler, Washington, D.C. Details from AIEE, 33 W 39th St, New York 18, New York.

**Jan 21—Engineers Joint Council,** 1st general assembly and banquet. Hotel Statler, New York, N. Y. Details from EJC, 29 W 39th St, New York 18, New York.

**Jan 23-27—Associated Equipment Distributors,** 36th annual meeting. Conrad Hilton Hotel, Chicago, Ill. Details from AED, 30 E Cedar St, Chicago 11, Illinois.

**Jan 24-27—Plant Maintenance and Engineering Show,** 6th exposition. International Amphitheatre, Chicago, Ill. Information from Clapp & Poliak, Inc, 341 Madison Ave, New York 17, New York.

**Jan 24-28—American Society of Heating and Ventilating Engineers,** 61st annual meeting and 12th International Heating and Ventilating Exposition. Commercial Museum and Convention Hall, Phil-


**ELECTRIC SYSTEM OPERATION**

*Just Published!*

Describes in detail the operation of generating, transmitting, and distribution equipment covering the major problems in running an electric system safely and economically. Reviews electric utility system from fuel input and water flow to customer's connections. Shows operations involved in scheduling and maintaining equipment. Prepared by specialists under editorship of B. G. A. Skrotzki, Assoc. Ed., POWER. 370 pp., 278 illus., $6.50

**ELECTRIC TRANSMISSION AND DISTRIBUTION**

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Describes simply and clearly the equipment used in transmission and distribution of electric energy from generating station to consumer, including overhead and underground circuits, high and low voltage circuits, protection against short circuits and lightning, and street lighting. Explains actual layout of equipment and what it does in the system. Prepared by specialists under editorship of B. G. A. Skrotzki, Assoc. Ed., POWER. 448 pp., 291 illus., $7.50

**DIESEL ENGINE OPERATION AND MAINTENANCE**

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What makes diesel engines run—and what it takes to keep them running smoothly—is disclosed in this practical treatment. Develops understanding of principles behind workings of a diesel engine, plus familiarity with design and function of its main components. Includes maintenance methods . . . how and when to overhaul diesels . . . simple ways to make repairs. By V. L. Maleev, Thermo. Eng'r., North American Aviation Corp. 504 pp., 357 illus., $8.50

**PIPING HANDBOOK**

*Rev. 4th Ed.*
*Just Published!*

Gives you a vast compilation of data and methods for the most effective uses of piping . . . principles that influence the design, construction, and use of piping systems. Covers steam power plant piping, building heating systems, plumbing systems, refrigeration piping, hydraulic power transmission piping, refinery piping, and many others. Revised Fourth Edition features data on formulas for pipe wall thicknesses, gas and air piping, and allowable stresses. By S. Crocker, Mech. Eng'r., Kinnear Services, Inc. Revised Fourth Edition, 1376 pp., 763 illus., $10.00

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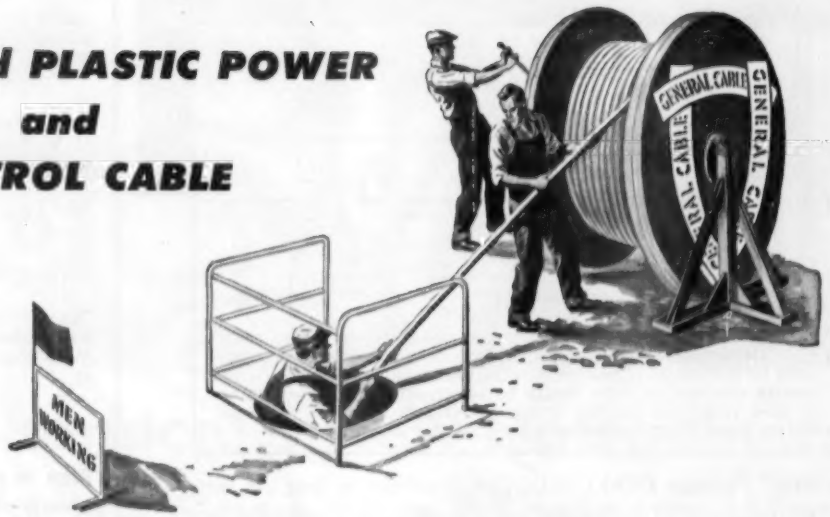


Besides offering the most complete line, General Cable makes top notch engineering service and useful product information easily available.

Rubber and Plastic Power and Control Cables are designed for power transmission, distribution and control...for duct and conduit installation...for direct earth burial...for submarine and aerial use (self supporting types are available).

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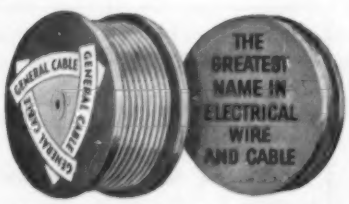


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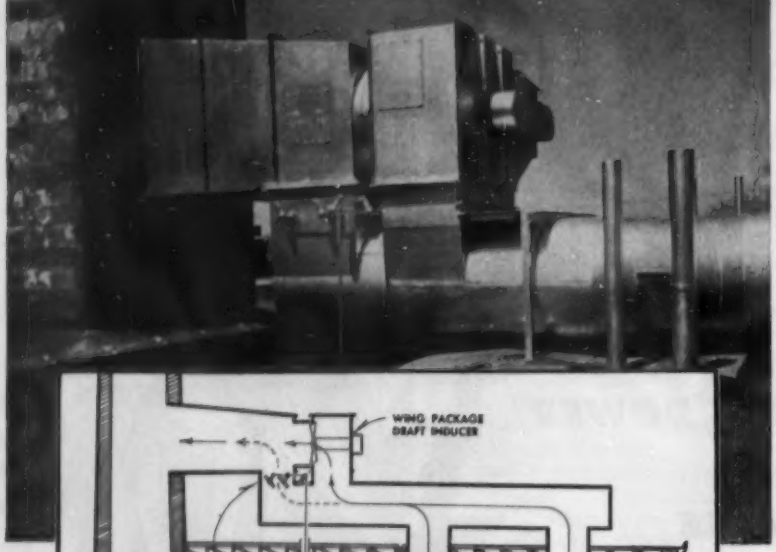
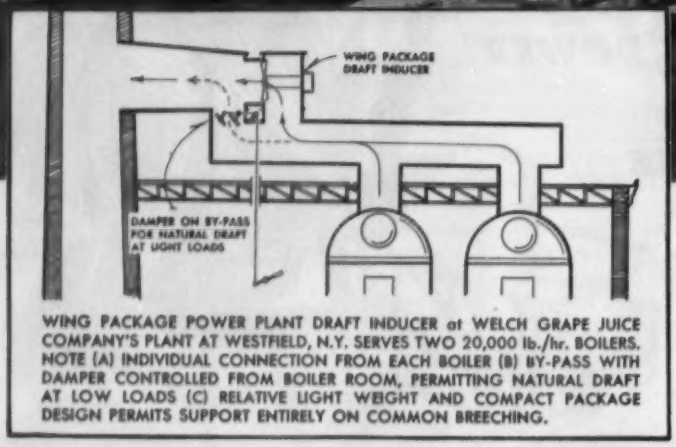
# The WING Package DRAFT INDUCER






WING PACKAGE POWER PLANT DRAFT INDUCER at WELCH GRAPE JUICE COMPANY'S PLANT AT WESTFIELD, N.Y. SERVES TWO 20,000 lb./hr. BOILERS. NOTE (A) INDIVIDUAL CONNECTION FROM EACH BOILER (B) BY-PASS WITH DAMPER CONTROLLED FROM BOILER ROOM, PERMITTING NATURAL DRAFT AT LOW LOADS (C) RELATIVE LIGHT WEIGHT AND COMPACT PACKAGE DESIGN PERMITS SUPPORT ENTIRELY ON COMMON BREECHING.

The WING Package DRAFT INDUCER is unique in that the motor (or turbine) and fan is designed as one complete removable unit, making installation easier and being easily removed, facilitates inspection and maintenance. Other advantages are:

1. Big savings in space requirements
2. Permits fewer and lighter structural supports
3. Eliminates field line-up problems
4. Eliminates water cooling
5. Only two support bearings
6. Wide flexibility in gas outlets
7. Saves on investment and maintenance
8. Low load ratings on natural draft because of ample free gas travel area

*Write for complete details*

**Wing**

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50 Vreeland Mills Road
Linden, New Jersey

## More POWER NEWS

Begins on page 150

adelphia, Pa. Details from ASHVE, 62 Worth St, New York 13, N. Y.

**Jan 26-28—Instrumentation for the Process Industries,** 10th symposium. College Station, Texas. Complete information from School of Engineering, University of Texas, College Station, Texas.

**Jan 31-Feb 4—American Institute of Electrical Engineers,** winter general meeting. Statler Hotel, New York, N. Y. Information from AIEE, 33 W 39th St, New York 18, New York.

**Jan 31-Feb 4—American Society for Testing Materials,** committee week. Netherland Plaza Hotel, Cincinnati, Ohio. Complete information from ASTM, 1916 Race St, Philadelphia 3, Pennsylvania.

**Feb 23—Instrument Society of America,** annual winter conference of New York section. Hotel Statler, New York, N. Y. Direct inquiries to Mr Hamilton Bristol, general chairman, c/o Bristol Co, 250 W 57th St, New York, New York.

**Mar 1-2—First International Congress on Air Pollution,** Hotel Statler, New York. N. Y. Details from ASME, 29 W 39th St, New York 18, New York.

**Mar 14-15—Steel Founders' Society of America,** annual meeting. Drake Hotel, Chicago, Ill. Information from SFS, 920 Midland Bldg, Cleveland 15, Ohio.

**Mar 28-Apr 1—Ninth Western Metal Exposition,** Pan-Pacific Auditorium, and Ninth Western Metal Congress, Ambassador Hotel, Los Angeles, Calif. Details from ASM, 7303 Euclid Ave, Cleveland 3, Ohio.

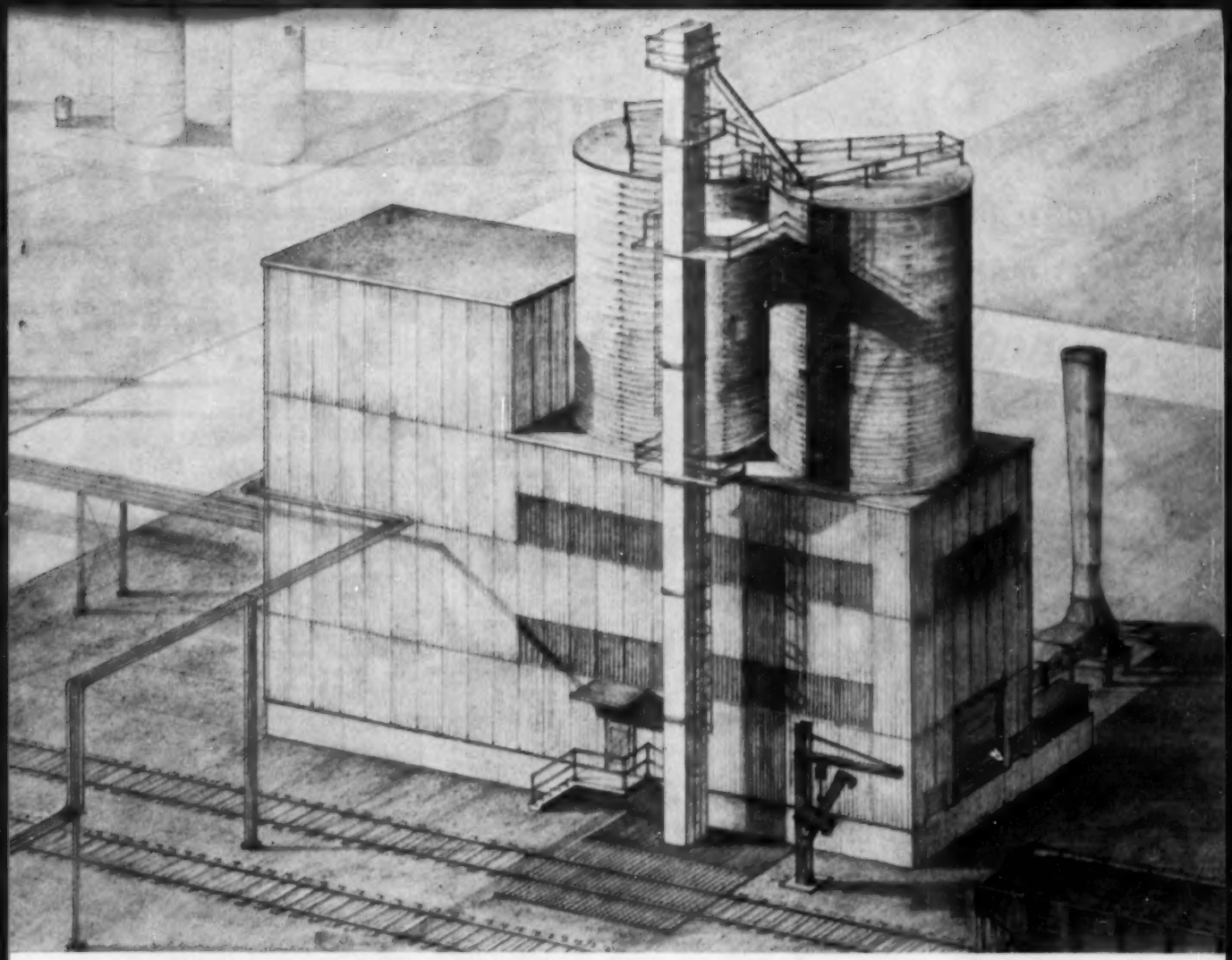
### Plan to produce extruded aluminum-sheathed cable

► General Cable Corporation plans to provide industry with this country's first direct-extruded aluminum sheathed cables. Arrangements have been completed for the purchase, from a West German firm, of an aluminum sheathing press to extrude aluminum sheathing directly onto an insulated cable core.

The new sheathing method is said to give lower cost, lighter weight and greater mechanical strength.

**Modernization Awards**

To learn how you can win recognition for your accomplishments, see pp 80-81.



# Stauffer Chemical's New Petrochemical Plant Burns Coal the Modern Way

When Stauffer Chemical Co. constructed a multi-million dollar Petrochemical plant in Louisville, Kentucky, the Process Engineering firm of Singmaster & Breyer specified and built a modern coal burning boiler plant (shown above)—incorporating a fully automatic combustion system, completely up-to-date coal and ash handling equipment.

The results? Fuel and labor costs are at a minimum. Dust concentration is well within the limit fixed by the Louisville Air Pollution Control Commission. Initial cost of the plant was $6.38 per pound of steam per hour, compared to an average $8 to $10 for plants the same size. And total cost of steam—including fuel, labor, maintenance, power, and fixed costs—is only 60c per 1000 pounds!

## Investigate Your Fuel Costs

If you're planning to modernize your plant or build a new one—or if you are just interested in cutting fuel costs—find out how coal, burned the modern way, compares to other fuels. Talk to a consulting engineer or your nearest coal distributor. Their advice may save you thousands of dollars each year.

## *facts* you should know about coal

In most industrial areas, bituminous coal is the lowest-cost fuel available.

Up-to-date coal burning equipment can give you 10% to 40% more steam per dollar.

Automatic coal and ash handling systems can cut your labor cost to a minimum.

Coal is the safest fuel to store and use. No dust or smoke problems when coal is burned with modern equipment.

Between America's vast coal reserves and mechanized coal production methods, you can count on coal being plentiful and its price remaining stable.

For further information or additional case histories showing how other plants have saved money burning coal, write to the address below.

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# BOOKSHELF

**Heat Transmission** (*Third edition*). *By William H McAdams, professor of chemical engineering, Massachusetts Institute of Technology. 6x9, 522 pp, $8.50, McGraw-Hill Book Company, 330 W 42nd St, New York 36, N. Y.*

This text, sponsored by the committee on heat transmission, National Research Council, has been the outstanding book in its field for many years. This revision reflects progress made in the field of heat transfer since the second edition was published in 1942. Old material has been simplified and new material added. Improvements include extensive use of analytical methods, expanded derivations, and the use of more descriptive matter.

One of the most important changes is revision of the chapter on radiant-heat transmission. The section on gas radiation has new charts for evaluating emissivity due to sulfur dioxide, carbon monoxide and ammonia. Carbon dioxide and water-vapor charts have been expanded to permit estimation of radiation at rocket-gas temperatures. New chapters cover natural convection, compact exchangers and high-velocity flow—rarefied gases.

**Betz Handbook of Industrial Water Conditioning.** (*Fourth edition*). *8x11, 248 pp, 213 illustrations, tables and graphs, two colors. $3.00. W H & L D Betz, Gillingham and Worth Sts, Philadelphia 24, Pa.*

Here is practical and up-to-date information on water conditioning for engineers, chemists, consultants and others concerned with water in industry. Specialized knowledge of chemistry and engineering is not needed to use this book.

Introductory chapters deal with basic water treatment processes like aeration, coagulation, softening, etc. Then specific water problems, particularly those met in boiler and cooling-water systems, are discussed. Applications and limitations of various water-treating methods and equipment are covered in detail.

**Thermodynamics Refresher for Professional Engineers License.** *By John Constance, P.E. 11x8½, paper, 150 pp, diagrams, tables, problems. $3.25. Published by author at 625 Hudson Terrace, Cliffside Park, New Jersey.*

Designed to aid engineers in training and candidates for professional licenses, this refresher is well suited for home study when regular courses are unavailable. It is also useful for operators studying to take examinations for stationary licenses.

Subjects covered include a short outline of chemistry and physics and a comprehensive discussion of thermodynamics and heat. Besides basic processes under the latter heading, the refresher covers steam plants, internal-combustion engines, refrigeration, heat transfer and fundamentals of air conditioning.

Illustrative problems throughout each section make the refresher useful for those whose math is a bit rusty. A large number of practice problems permit easy testing of one's grasp of principles and methods.

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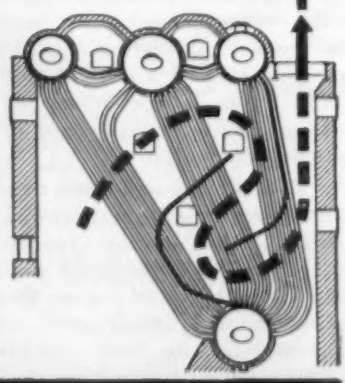

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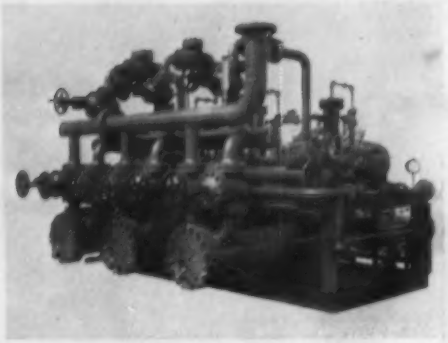
# LOCKETT FUEL OIL PUMPING AND HEATING SETS



The compact, high-pressure Unit shown consists of one Turbine-driven and two Motor-driven Pumps, and three Shell-and-tube-type Oil Heaters mounted on a single frame. Capacity 50,000 pounds per hour of banker C fuel oil against 400 P.S.I. One pump and heater are spares.

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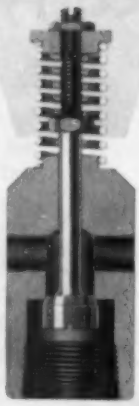

Foster makes a complete line of spring loaded automatic valves for use in vacuum service — with simple types for protection of stills, heater shells and similar equipment against collapse when cooling down, and more sensitive types for close control of vacuum in manifolds, air lines, and vapor lines for various processing requirements.

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# APPOINTMENTS

## Corporation executive changes

**Mercast Corp:** Alan G Kirk, president. **Perfex Corp:** Irving G Bohrman, president; Ernest H Panthofer, vice-president. **J F Pritchard Co:** H Arthur Martin, executive vice-president; W Earl Dunn, H M Low, A Russell Young and W W Deschner, vice-presidents; Karl E Johnson, vice-president and general manager of J F Pritchard Co of California; H R Oglesby, vice-president and general manager of Municipal Service Co. **Nickel Cadmium Battery Corp:** Grenville B Ellis, executive vice-president.

**Clark Bros Co:** F H Hayes and A K Hegeman, vice-presidents. **Kieley & Mueller, Inc:** Norman Lieblich, vice-president. **Eclipse Fuel Engineering Co of Canada, Ltd:** Bert H McGill, president and general manager. **Robertshaw-Fulton Controls (Canada) Ltd:** John A Robertshaw, president; George A Elliott, vice president and general manager.

## Operation executive changes

**Dodge Manufacturing Corp:** Carl W Petersen, vice-president and works manager. **General Electric Co:** Russell E Meyers, manager of manufacturing and engineering for capacitor dept; William S Ginn, general manager of transformer div. **Anaconda Wire & Cable Co:** Victor di Lustro, general manager of all mills; C F Randall, manager of production planning.

## Engineer changes

**De Laval Steam Turbine Co:** Harry Engvall, executive engineer; John S Haverstick, chief engineer. **General Electric Co:** Francis L Woods, manager of engineering for distribution transformer dept. **Worthington Corp:** Joseph B Inferrera, executive engineer at Wellsville, N. Y. plant. **Minneapolis-Honeywell Regulator Co:** Ralph A Rockwell, chief engineer for valve division.

**The Ohio Injector Co:** Norman A Malone, chief manufacturing engineer. **Brown Boveri Corp:** Ledo R Carletti, in charge of consultation on supercharging of diesel and gas engines. **General Electric Co:** Donald K Miner and J David Benedict to vacuum-melted alloys section of Carboloy dept. **Bailey Meter Co:** C D Shanks, resident engineer with headquarters in Charleston, W. Va. **Wilkening Manufacturing Co:** John O Lutz, ass't chief engineer.

## New sales managers

**The Youngstown Sheet & Tube Co:** John M Tuthill; P G Boyd, Western district; C Hix Jones, Chicago district; David H Goodfellow, Detroit district. **U.S. Rubber Co:** Matthew J Delehaunty, mechanical goods div. **Ana-**

# HOW TO BUY V-BELTS

## FOR MORE POWER AND LONGER LIFE

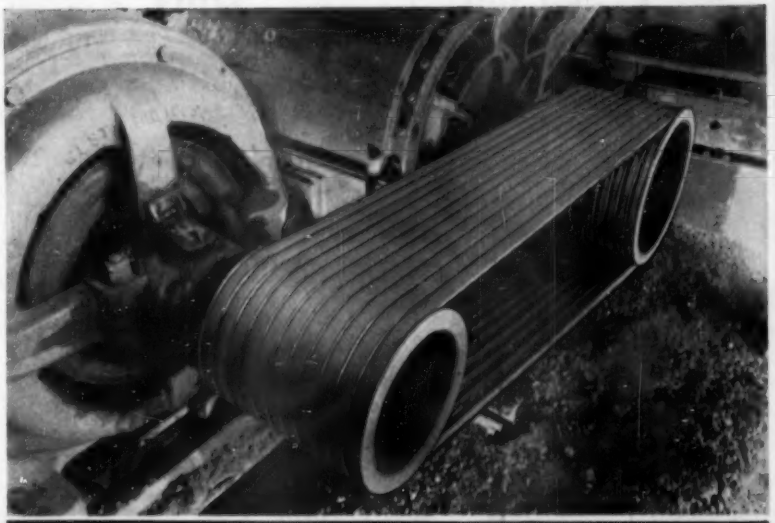
### ...and get "More Use per Dollar"

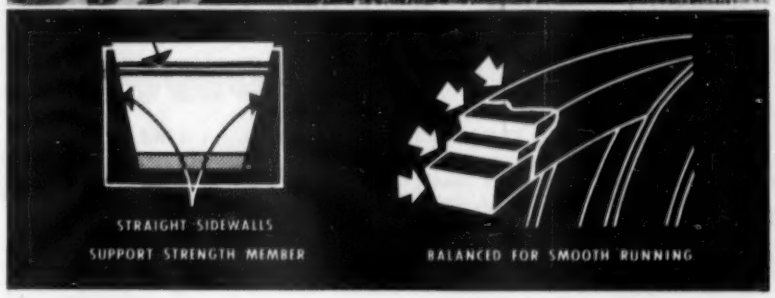
Look for a belt with straight sidewalls and accurately positioned strength members that prevent sag in the "power line".

The "power line" or pulling section is the heart of a V-belt. It is here the belt strength members are located and it sets the load-carrying capacity of the drive.

Straight sidewall construction assures firm pressure in the lower or compression section of the V-belt so that when it rounds the pulley it supports the strength member in a straight line. All cords of the strength member should pull equally. If they "sag", as in some constructions, the outer cords are overworked and premature failure results. In addition, straight sidewalls exert a firm side-grip on the sheave grooves, eliminate slip and power waste.

Specify, by name, the V-belt most carefully manufactured so that every part is balanced to deliver full horsepower capacity and "More Use per Dollar" . . . specify R/M Super-Power or standard Condor V-Belts.






## R/M SUPER-POWER AND CONDOR V-BELTS

For longer life under shock loads, R/M Super-Power V-Belts have a new synthetic super strength member which delivers up to 40% more horsepower capacity; fewer belts can be used on the same drive for the same horsepower. They are oil-proof, non-spark and heat resistant. Both R/M Super-Power and standard Condor V-Belts have straight sidewalls with strength members micro-positioned and destretched during manufacture. This prevents power waste and frequent shutdown for belt take-up. Let an R/M representative show you why R/M Super-Power or Condor V-Belts last longer . . . give you "More Use per Dollar".

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# More APPOINTMENTS

*Begins on page 228*

**conda Wire & Cable Co:** H V Van Valkenburg; C B Peck Jr, industrial sales; J L Tindale, utility sales; H E West, contractor sales; A W Koch, magnet wire sales; Ernest B Miller Jr, Chicago district; John N Ratcliff Jr, Houston district.

## Institute elections

**American Welding Society:** Joseph H Humberstone, president; J J Chyle, 1st vice-president; C P Sander, 2nd vice-president. **Conveyor Equipment Manufacturers Association:** Jervis C Webb, president. **National Electrical Manufacturers Association:** Albert F Metz, president; W A Elliott, F F Loock, J J Mullen Jr, B C Neece and W V O'Brien, vice-presidents.

**National Industrial Leather Association:** J N Smith, president; David S Williams, vice-president; C C Bradbury, Lester H Shingle and David S Williams, directors. **Caster & Floor Truck Manufacturers Association:** Kenneth F Heath, president; D B Anderson, vice-president; J S Hanson, H A Ford and J W Hutchison, directors. **Vertical Turbine Pump Association:** Warren L Bremer, president; William H Reeves, vice-president.

## Retirements

**Henry V Nye,** consulting engineer for switchgear equipment, Allis-Chalmers Manufacturing Co, after 48 yrs. **Walter F Klump,** manager of Chicago district purchasing office, The Youngstown Sheet & Tube Co, after 36 yrs. **John M Birkenstock,** general manager and director, The Green Fuel Economizer Co, Inc, after 30 yrs. **Fred P Hays,** Cleveland district manager, Norton Co, after 38 yrs. **Ernest Hartford,** deputy secretary, American Society of Mechanical Engineers, after 43 years of service to the society.

## Obituaries

**Edward H Coe,** 65, retired president and honorary chairman of executive committee, Arizona Public Service Co, October 31st.

**Clifford S Anderson,** 76, advisory counsel, Norton Co, November 10th.

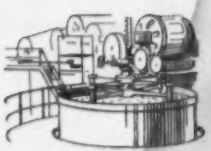
**Richard H Patch,** 66, vice-president operations, E F Houghton & Co, November 13th.

## Modernization Awards

To learn how you can win recognition for your accomplishments, see pp 80-81.

# this flow-control approach

## *provides economical solution to every industrial water treatment problem*



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**IN PROCESS WATER TREATING SYSTEMS**—accurate metering of chemicals assures efficient processing, reduced chemical costs and increased equipment life. Controlled Volume Pumps, or a Milton Roy chemical feed systems, provide reliable accuracy in softening, coagulation, demineralization, and other process water treatments.

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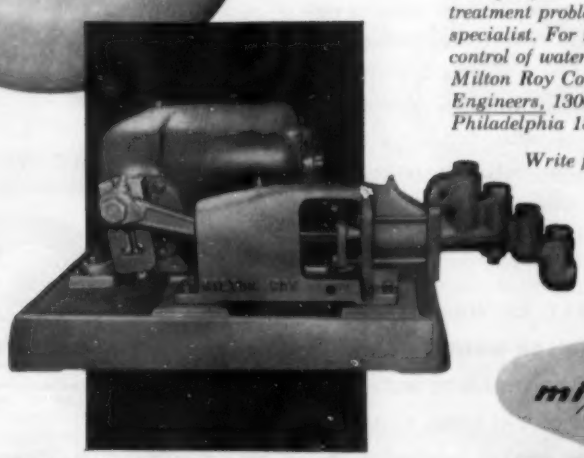
**COMPARE THE COST** of replacing a cooling tower whose wood has delignified . . . of scaled boiler tubes . . . of an off-quality product—with the cost of an efficient Controlled Volume Pump. Can you really afford *not* to invest in Milton Roy precision flow-control?

*For specific recommendations on water treatment problems, see your consulting specialist. For reliable, accurate flow control of water treating chemicals, see Milton Roy Company, Manufacturing Engineers, 1300 East Mermaid Lane, Philadelphia 18, Pa.*

*Write for technical information.*



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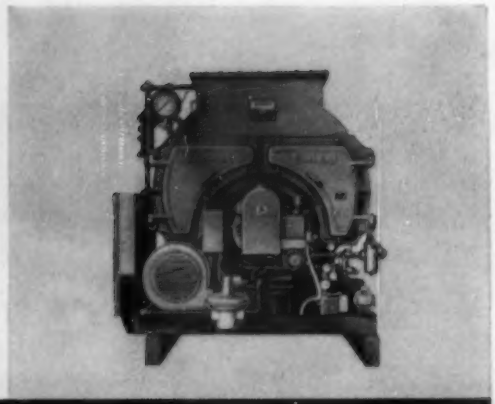
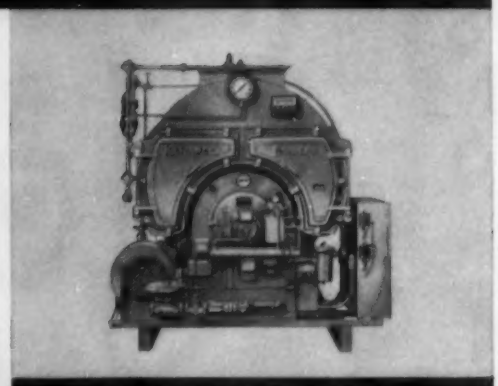
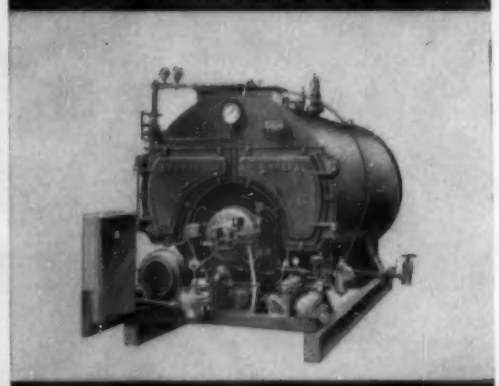


KEWANEE-IRON FIREMAN BOILER-BURNER UNIT



KEWANEE-RAY BOILER-BURNER UNIT



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Planned as perfectly integrated units—combined for the highest in efficient performance—these 3 matched Boiler-Burner Units represent the merged knowledge, experience and judgment of experts in both boiler and burner fields. Here, truly, are 3 of the finest Boiler-Burner Units for high or low pressure heating—power and process steam—oil, gas, or oil-gas combinations. You can be sure of dependable performance from a ...

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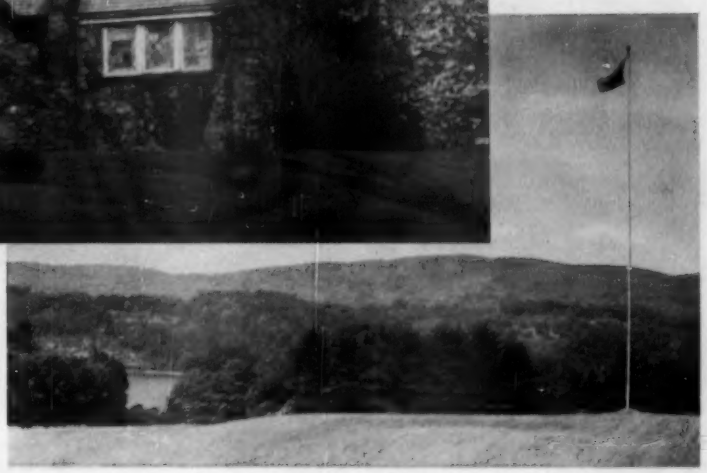
# TAYLOR, OF COURSE!



**Taylor stokers at the Hudson River State Hospital, Poughkeepsie, N. Y., assure freedom from stack nuisance for this modern institution comprising 80 buildings and 890 beautifully developed and landscaped acres. Pictured above is one of the chapels; at right, a view from steps of the Main Building.**

Taylor multiple retort underfeed stokers are today's first choice with state institutions, colleges, hospitals, and heating plants in the heart of cities. This is only natural, for properly engineered Taylor Stokers abolish the stack discharge nuisance once and for all—without costly dust collectors and consequent draft losses!

Furthermore, Taylor's smokeless operation is proof of superior combustion and fuel economy. Wet coals and low grade coals are no problem. Refuse is a desirable by-product instead of an added expense. And Taylor can handle widely varying loads with long-continued low steaming rates ...load variations of 20 to 1 or more are common.

The Taylor Stoker is backed by an organization with reliable service stations in Philadelphia, Dayton and Detroit...Whether your new boiler must deliver 20,000 or 500,000 lbs. of steam per hour, ask your Consulting Engineer about Taylor Stokers. And write us for a copy of free booklet giving full information about Taylor, the completely modern stoker with the old, old name. American Engineering Company, 2400 Aramingo Avenue, Philadelphia 25, Pa.

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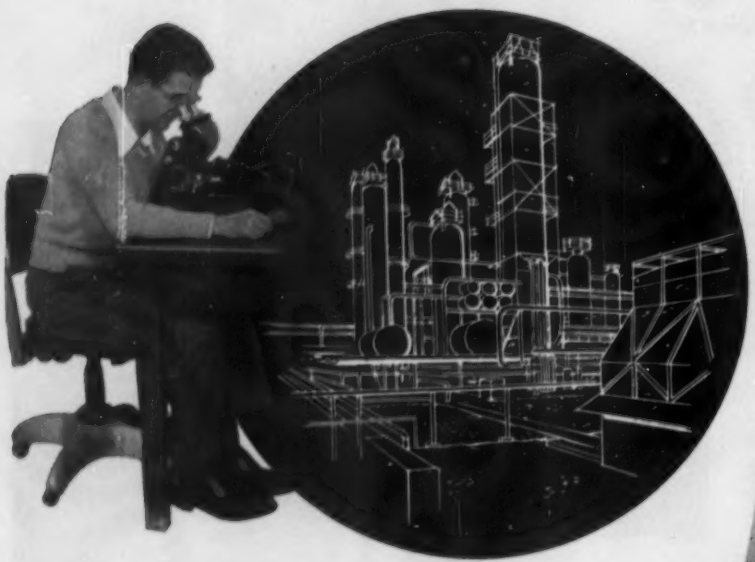
**AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists and Car Pullers.**

## *is corrosion costing you too much?*



***our job at Globe is to keep this costly problem at a minimum — through the use of GLOBE Steel Tubes, produced for your specific requirements!***

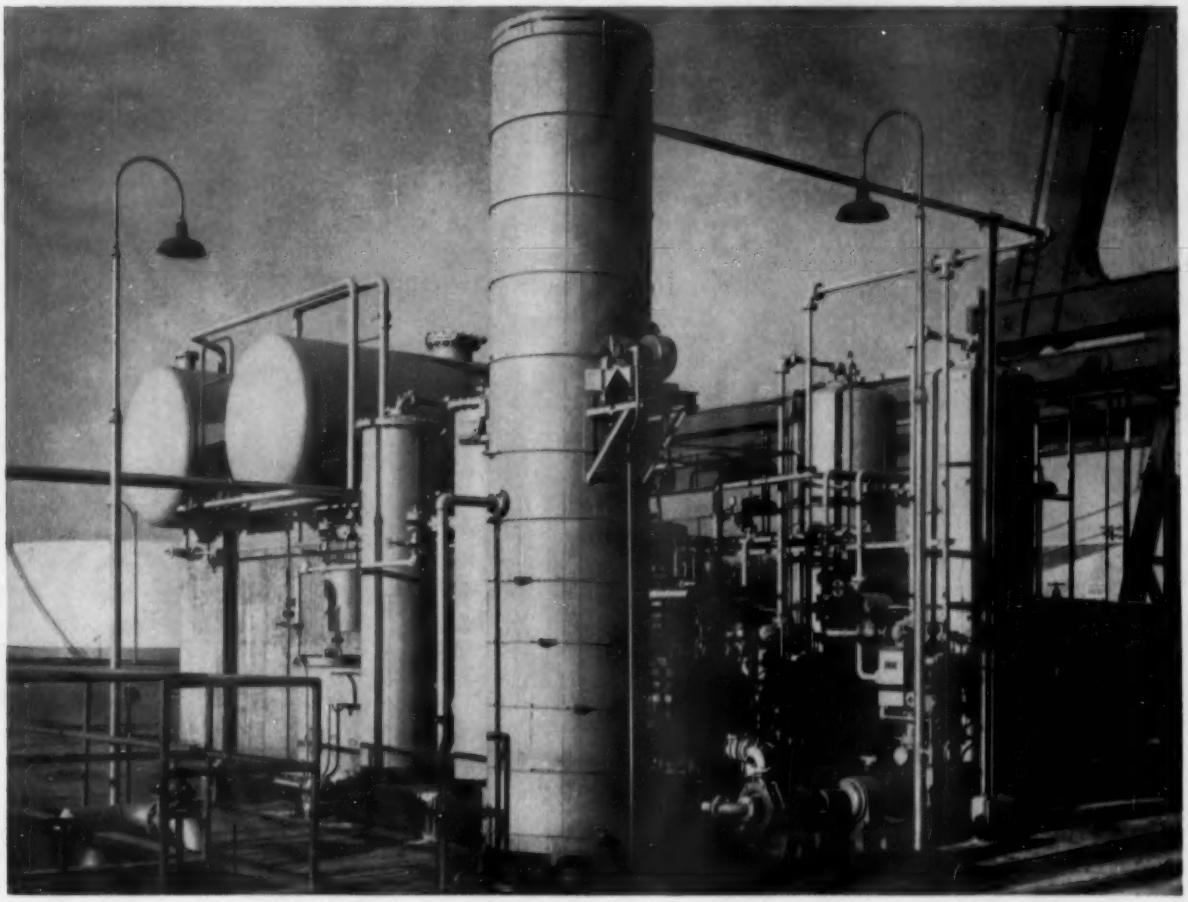
THERE are over twenty-five basic grades of stainless steel tubing, variations of which add up to many more analyses which can be employed in solving your corrosion problems.

Globe's metallurgists and engineers help you minimize the expense caused by corrosive attack. By careful laboratory and field study of your processes and products, they will recommend just which of the many available analyses of Globe tubing is best suited to your job.

Globe's "one source" supply offers seamless and welded stainless, and seamless carbon and alloy steel tubes in a complete range of sizes and analyses. Write for the Globe General Catalog.

**Producers of Globe seamless stainless steel tubes — Globeweld welded stainless steel tubes — seamless alloy and carbon steel tubes — seamless Globeiron (high-purity ingot iron) tubes — Globe Welding Fittings**

# 3 SOLUTIONS FOR YOUR BOILER FEEDWATER PROBLEMS



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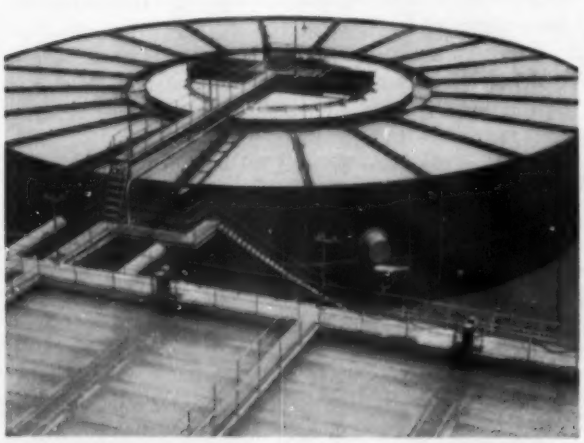
**2. ACCELATOR® Treating Plants:** The "ACCELATOR" treating plant with appropriate chemical feeding equipment and auxiliaries affords in many cases a satisfactory means of treating feedwater for low pressure boilers or for pretreating feedwater for higher pressure boilers. They have a proven record of flexibility, ease of operation and chemical economy.



**3. Hot Process Softeners:** For the intermediate range of boiler pressures, INFILCO Hot Process Softeners with Hot Process Zeolite Units provide low alkalinity, low hardness and low silica content feedwater at moderate chemical cost.

**Engineering Experience:** Complete engineering know-how plus many years of experience has made INFILCO the leader in its field. Our field engineers are available to suggest practical solutions for your feedwater problems. Write today for complete information to

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# Fly Ash Problem Solved By Central Station

This Pennsylvania utility felt that as long as you can *see* dirty stack discharge, you have a problem. To solve it, they decided to insist on fly ash collection equipment with very high efficiency.

The electrical precipitators they chose, which were placed after existing mechanical collectors, are Cottrells, designed and built by Research-Cottrell. Their effectiveness is demonstrated in the above unretouched photographs. At the left, the precipitators were turned off long enough to take the picture showing the volume of fly ash discharged by the boilers. At the right, the precipitators are turned back on. Stack discharge is visually clean.

This is another example of industry's trend toward establishing its own higher standards for nuisance abatement. Research-Cottrell, which has made more fly ash installations than any other company, cites the following comparison:

In the period from 1923 to 1939 only 11% of its power plant customers specified fly ash collection efficiency of 95 to 98%. In recent years, that 11%,has risen to fully 90%.

One reason, of course, is the generally increasing emphasis on community relations. Another factor is that farsighted companies are anticipating stricter smoke regulations. They are anxious to install equipment that will end their smoke problems now and also prevent such problems from occurring in the future.

Still another factor is this. In recent years, with modern coal pulverization and advanced boiler design, there has been an increase in the fineness of fly ash particles. This calls for the most efficient equipment available.

Read—in Bulletins FA and MI—about Cottrell equipment and the Research-Cottrell's MI Rapper. This device eliminates rapping puffs and enables the precipitator to maintain, continuously, its high collection efficiency. Write for your copies today.

RC-183

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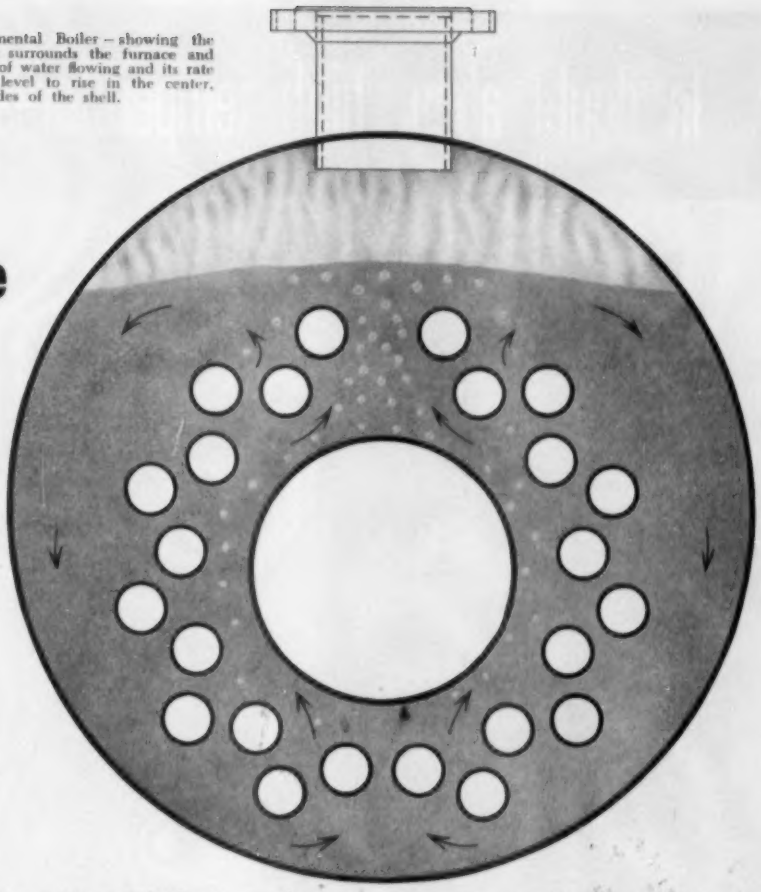
Cross-section of a Continental Boiler – showing the free flow of water which surrounds the furnace and return tubes. The volume of water flowing and its rate of flow cause the water level to rise in the center, then fall away to both sides of the shell.



# What makes the Continental Boiler last longer... makes steam cost less

If you were to design a packaged boiler, water circulation would be a basic consideration because . . .

. . . poor circulation can cause overheating . . . can cause unequal stress in metal heating surfaces . . . can promote pitting and scaling on metal surfaces exposed to water . . . and can result in higher stack temperatures, decreased boiler efficiency.

But the many owners of Continental Boilers have had none of these troubles. Here are two special reasons why:

**1. Two-pass design provides even flow of combustion gases to all heating surfaces.**

Heat is thus distributed evenly to the rear tube-sheet and to all of the return tubes. Water is heated uniformly, and natural, balanced circulation results.

If high temperature combustion gases were to enter only one section of the return tube bank, the tubes in that section would be at a higher temperature, would be doing more work than the balance of the tube-sheet and return tubes. The result: water surrounding those cooler heating surfaces would have sluggish circulation.

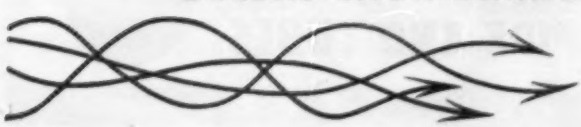
**2. Heating surfaces in the Continental Boiler are arranged so that there is a centrally located furnace and equal spacing of return tubes.**

Of the total heat transferred to the water within a Continental Boiler, about 60% is transferred by the furnace. Thus it is essential that flow of water around the furnace be unrestricted. Note the area around and above the furnace and the open channel along both sides of the boiler shell. This design assures unrestricted flow of water around the furnace . . . facilitates rapid flow of water to the bottom of the boiler for reheating.

Uniform . . . free . . . rapid water circulation is an important reason why a Continental Boiler costs little to keep, has long service life, and makes steam cost less. For detailed information write for Bulletins BE-3, BE-4.

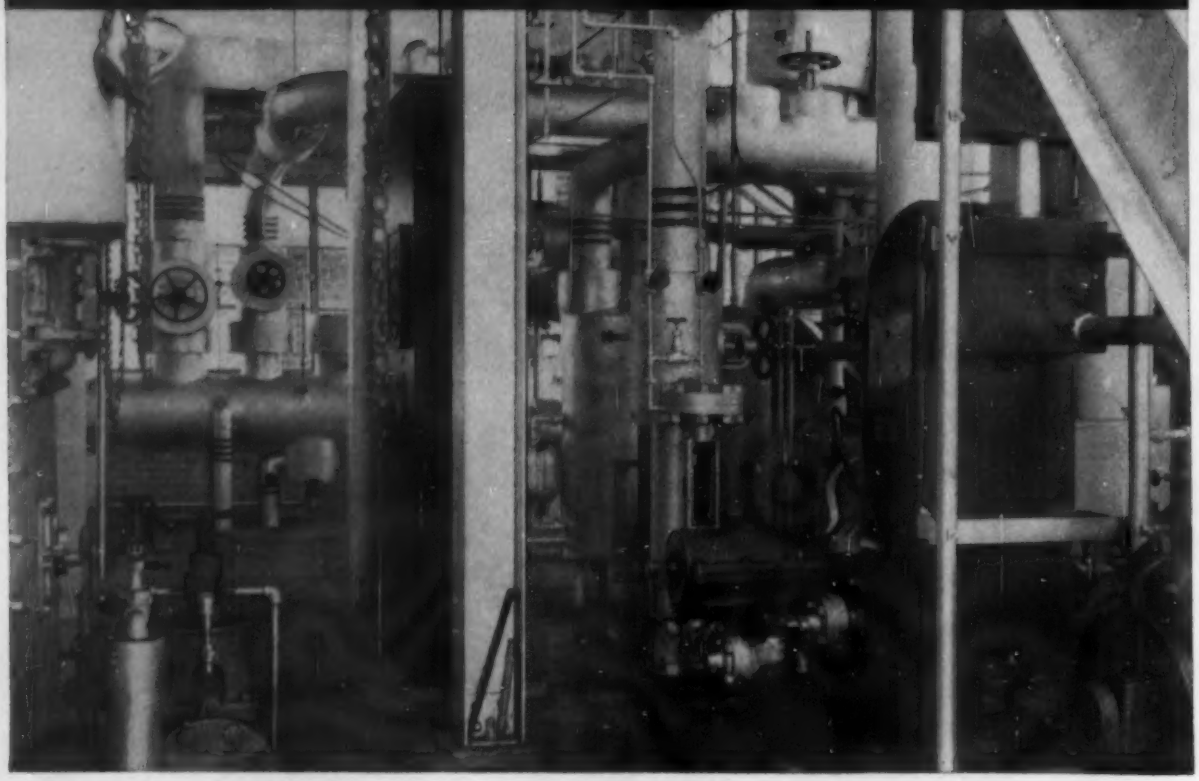
## BOILER ENGINEERING & SUPPLY COMPANY, INC.

*Phoenixville, Pa.*



**CONTINENTAL . . .**
**the boiler with the spinning gas technique**

# In doubt about high temperatures and pressures?



# Put your confidence in NATIONAL Seamless

● If you're planning a new power plant or repiping a present installation, you'll doubtless be dealing with higher pressures and temperatures than ever before. Your first consideration, naturally, will be the selection of the best possible material for your high pressure steam lines, since the life of your plant and the safety of your personnel may well depend on them. Consequently, you'll want the strongest, most dependable power piping you can buy—and that's SEAMLESS. Plant engineers know from long experience that there is no more dependable power piping than NATIONAL Seamless—the famous "Walls Without Welds."

You just can't beat USS NATIONAL Seamless Pipe and Tubes for power plant service—even under the most grueling service conditions. Pierced from solid billets of steel, NATIONAL Seamless Pipe and Tubes have the strength, uniformity, and dependability of solid forgings—properties that keep them structurally sound under intense pressures and ever-rising temperatures.

Write for further information on the use of NATIONAL Seamless Pipe and Tubes in safer, more dependable, more economical power installations. And for peace of mind when purchasing, always say "NATIONAL Seamless."

USS

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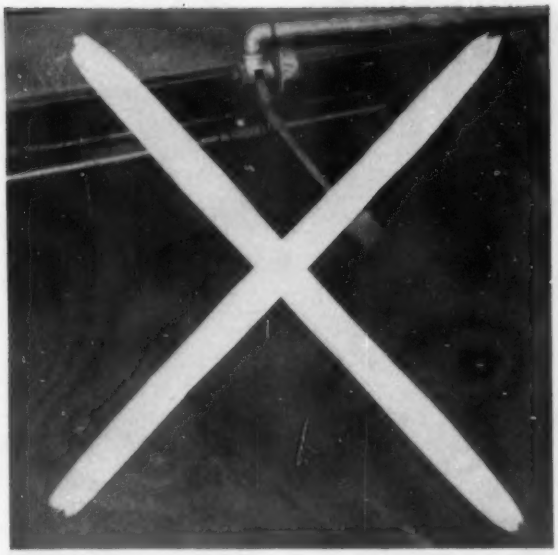
WALLS WITHOUT WELDS

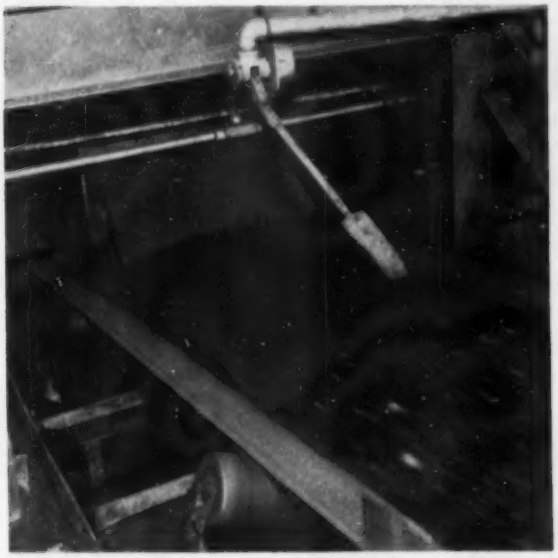
UNITED STATES STEEL



BEFORE—View of Coal Chute discharge onto conveyor belt at a New Jersey generating station without J-M system turned on.

# STOP COAL DUST

## in your operation at 1/10 the usual cost!



AFTER—Same view as above but with J-M dust control system in operation.

Here's improved appearance for your plant . . . better health for your employees . . . easier handling of your coal supply. A Johnson-March system can control or eliminate coal dust wherever it occurs in your operation *. . . at a cost only 1/10 that of most other dust control systems!*

A Johnson-March system can be installed right at car dumpers, hoppers, crushers, belt galleries or coal piles. Nothing to interfere with normal operations. So amazingly simple the maintenance cost is next to nothing.

Johnson-March systems are installed in many plants to improve the effectiveness of existing mechanical dust collection systems. If you now have no control over coal dust . . . or even if you have a mechanical dust collection system in your plant . . . it will pay you to consider the *low-cost* advantages of a Johnson-March system.

For more information on how a low-cost Johnson-March system can help solve *your* coal dust problems, send NOW for this FREE ILLUSTRATED BROCHURE.

THE JOHNSON-MARCH CORP. P-1
1724 Chestnut St., Philadelphia 3, Pa.

With no obligation, I want to know the facts about stopping coal dust with a low-cost Johnson-March system. Please send me the FREE ILLUSTRATED BROCHURE.

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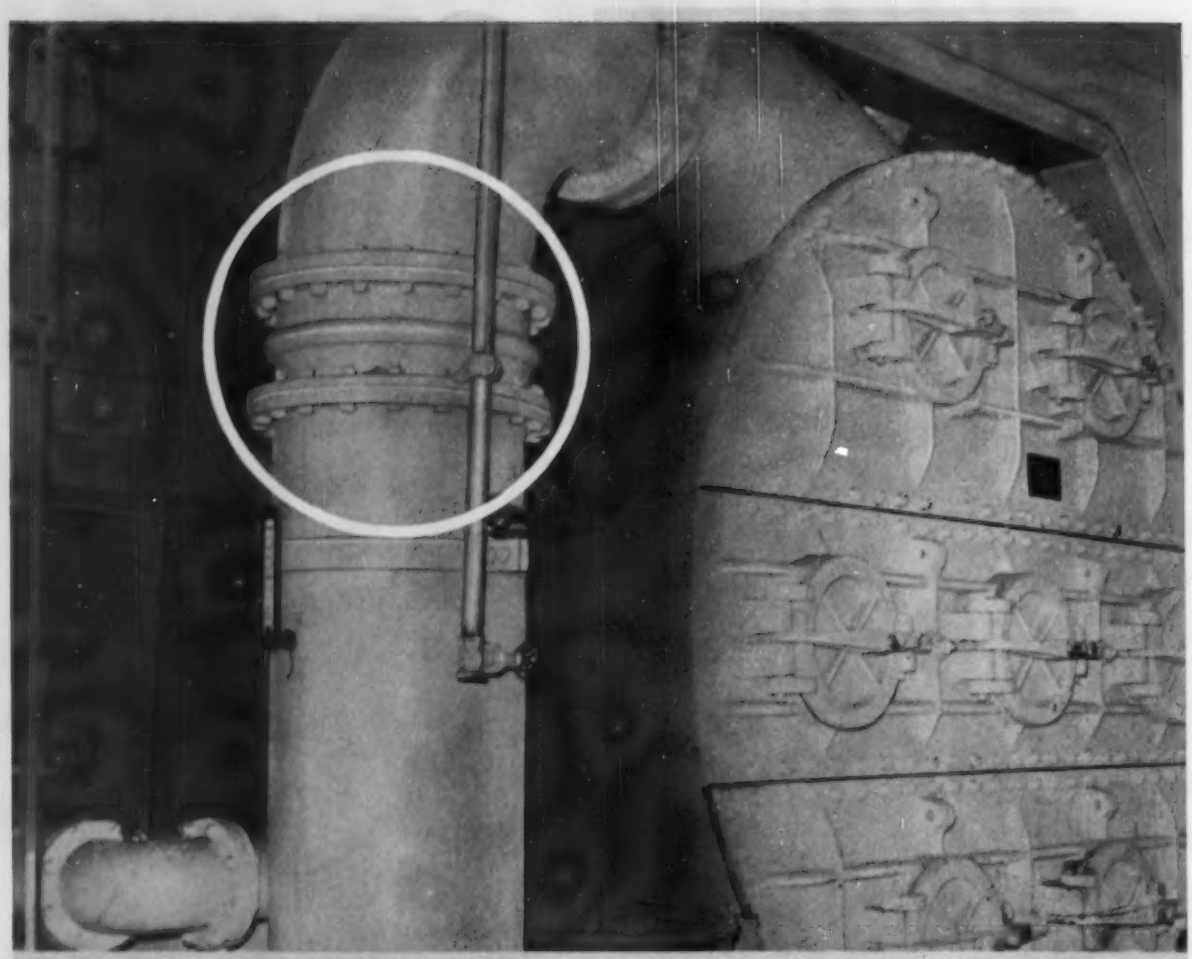
ADDRESS.....

CITY..... STATE.....

**Johnson March**

*Dust Control Engineering*

**1724 CHESTNUT ST.** **Philadelphia 3, Pa.**



# 30-YEAR SERVICE RECORD CHALKED UP BY U. S. EXPANSION JOINTS IN WEST COAST POWER PLANT

Above is one of 12 U.S. Expansion Joints installed 30 years ago in a California utility plant. Despite their age these joints are still functioning.

U.S. Rubber Expansion Joints are economical, flexible connections used in pipe lines to take up the stresses due to vibration, expansion and contraction. They prevent the transmission of noise, and take care of misalignment. They have no moving parts to wear or bind and thereby shorten service life.

U.S. Rubber Expansion Joints can be installed on both new and old piping and equipment. These joints plus engineering service are available through any of our 27 "U.S." District Sales Offices, or write address below.

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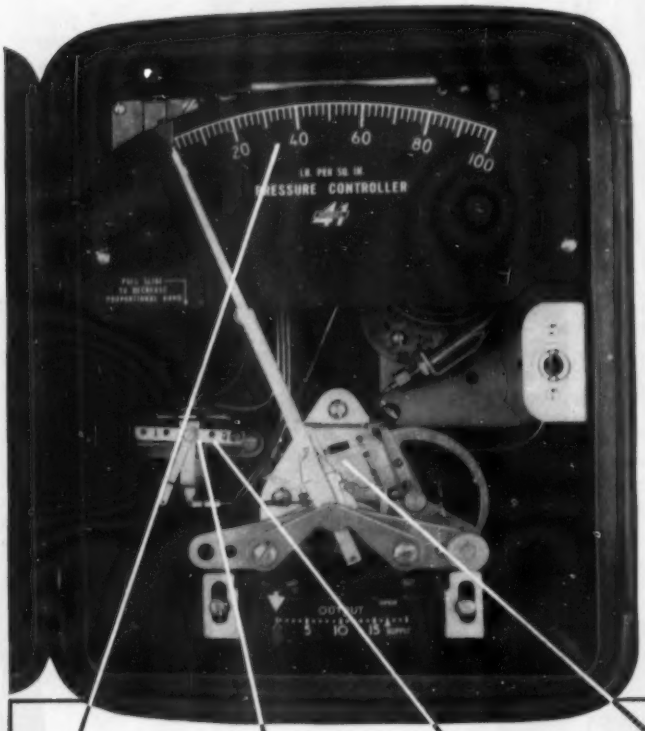
## ...the improved Foxboro M/41A Indicating controller




Here's the Foxboro Controller that proved itself in thousands of successful applications throughout industry! Now, with brand new design features, it's better than ever.

The M/41A Controller offers a new, snappy on-off action, or smooth proportional control action easily adjustable from .25% to 25%. It employs the famous M/40 controller movement — free from backlash, lost motion, and friction. This is a rugged, low-cost, compact controller using standard M/40 parts *throughout* . . . easy to get at . . . easy to service.

For control of simple processes—temperature, pressure, liquid level, or humidity — it will pay you to investigate the convenience and the precise, reliable performance of the Foxboro M/41A Indicating Controller. Write for Bulletin 5A-13.

### *New Design Features*

- Longer Scale — 5" effective length.
- Snappy "On-Off" Control Action on measurement change of only ⅛ of 1% scale.
- Alternate Proportional Action adjustable from ¼ of 1% to 25%.
- "Permaligned" Precision Controller Movement — Exclusive Self-Aligning Ball-Linkage—Non-Backlash Vernier Index Drive
- Simple Rugged Construction—All Parts Easily Accessible

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## Tube Cleaners

Wilson brings you a complete line of fast-acting tube cleaners. They handle every kind of deposit, hard or soft, thick or thin or variable in depth. Driven by air, steam, water or electricity, these powerful cleaners make quick work of cleaning straight or curved tubes.

## Tube Expanders

Wilson Tube Expanders are precision-made. Their smooth, efficient rolling action insures firm seating of the tube ... provides perfectly rolled joints ... reduces time-wasting re-rolling and re-inspection. There is a Wilson Tube Expander for every need from 3/16" ID to 12" ID and up.

## Special Tools

Wilson also offers a wide range line of boiler maintenance and erection tools. The handy chamfering tool shown at right chamfers the tube edge to a 45° surface at high speed ... makes repairs much faster than outdated hand methods. Also available is an inside chamfering tool for placement of chill rings. Write for more information on these tools.

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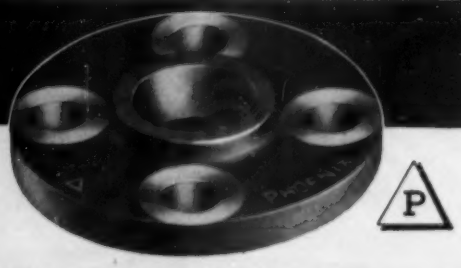

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FOR

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## motorized, push-button Valve Operation

This illustration shows an unique application of LimiTorque on one of six 24" gate valves supplied by Crane Company to Kaiser Engineers, Hanford, Washington. The extension spool permits the LimiTorque Electric Valve Operator to be located on a floor lever 15 feet above the centerline of the Valve. This is just one of the many unusual and effective applications of LimiTorque on Land and Sea.

Wherever convenient automatic valve operation is desired, or where an emergency may demand rapid, safe and positive remote operation — LimiTorque is the answer.

LimiTorque operates at the mere "push of a button" and thus, saves time, labor, and money required for manual operation of valves at distant or inaccessible locations. Further, LimiTorque opens and closes valves at the exact speed required, and it also "limits the torque" applied to valve operating parts, thereby preventing possible damage to valve stems, seats and discs. And too, the handwheel "cannot rotate" when the valve is being motor operated.

LimiTorque may be actuated by any available power source, such as Electricity, Oil, Gas, Water or Air; and is now available for Microwave control.

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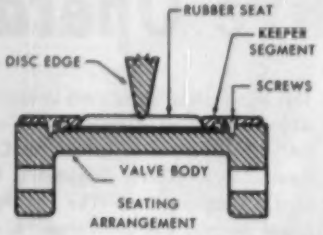
# Now!..Bottle-Tight Butterfly Valves in ratings to 125 P.S.I.

**Corrosion cannot hinder operation** . . . Even if not operated for long periods, a Henry Pratt Butterfly Valve will open or close easily. These valves are not subject to "corrosion seizing" because all seating surfaces are non-corrosive. The disc edge is either stainless steel or chrome-plated, and it closes into a thick rubber seat. These features, coupled with Oilite bearings and stainless steel shafting, make it impossible for valves to "corrode tight" either open or shut.

**Full 90° closure into Rubber Seat** . . . The disc diameter is slightly larger than the inside diameter of the rubber seat and thus when rotated to the full closed position the disc actually displaces the rubber. This seat has been designed so that the ratio of seat thickness to disc indentation insures bottle-tight shut-off while minimizing permanent set and excessive abrasion.

The resilient seat material is reinforced by heavy canvas insertions to increase seat strength. The seats are secured in the valve body by removable keeper segments.




Before shipment all valves undergo rigorous leakage tests to insure compliance with leakage guarantees.

**Sound design features in both low and high pressure ratings** . . . Valves are manufactured in sizes from 10 to 168 inches in diameter. Valve construction can be either cast iron or fabricated steel. Operator types available include hand wheel, chain wheel, limitorque electric motor, hydraulic cylinder, air cylinder, etc. All Henry Pratt Rubber Seat Butterfly Valves are suitable for an operating temperature range of −20° to +190°F.

54" Limitorque electric motor operated, low pressure standard rubber seat butterfly valve.

24" Handwheel operated, high pressure standard rubber seat butterfly valve.

HENRY PRATT

Write for full details . . .
"Understanding Butterfly Valves", Bulletin 2-K
Low Pressure Valves, Bulletin 1-K
High Pressure Valves, Bulletin 4-K

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# Butterfly Valves

Henry Pratt Company, 2322 S. Halsted St., Chicago 8, Ill. Representatives in principal cities

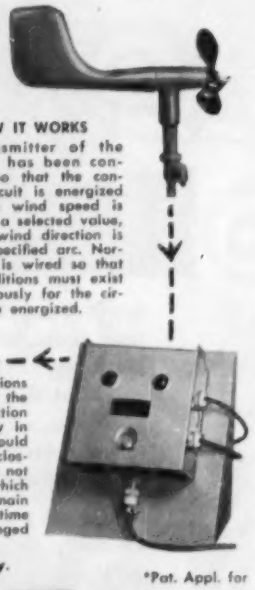
# AIR POLLUTION

## How To Make Your Smoke Stack Act Taller Than It Is!

**New wind operated, automatic controller energizes forced draft or heat systems under unfavorable meteorological conditions . . . thereby increasing "effective stack height." It's called The Bendix-Friez Windtrol*.**

For example, the plant that we're talking about has a relatively low stack. The release of fly ash with its stack effluent results in many complaints under certain meteorological conditions. How can this be corrected . . . without great expense? Let's see what the principles of stack meteorology can show us.

By checking wind speed and direction . . . unfavorable quadrant can be discovered. First, you install at near stack height the Bendix Windtrol Transmitter. This detects the wind speed and direction. The unfavorable quadrant is established for air pollution and the controller (located indoors on any convenient wall) is wired accordingly. The controller is then connected to a forced draft fan, a booster blower or a stack oil burner.



**HOW IT WORKS**

The transmitter of the Windtrol has been constructed so that the controller circuit is energized when the wind speed is less than a selected value, and the wind direction is from a specified arc. Normally, it is wired so that both conditions must exist simultaneously for the circuit to be energized.

Observations indicate that many situations will arise because of the gustiness of the wind in which either or both, the direction and speed will oscillate rather rapidly in the vicinity of the selected limits. This could result in intermittent and short period closures of the controlling circuit, were it not for a built-in time delay device which causes the actuating power relay to remain open or closed for a given length of time after the direction or speed has changed from the required limits.

**For further information, write today.**

*Pat. Appl. for

Bendix - Friez

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The facts are in! The story of American Crusher performance—rugged, long-life-low-cost performance—is now available for your careful study. Not just one case history, or scattered reports—but a thorough survey of American installations (power plants, central stations, and mines) across the nation. Here are the "crushing" facts:

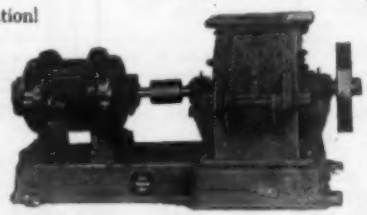
Total Tonnage Handled .....61,000,000 Tons
Average Age of Crushers .....9.5 Years
Replacement Parts (Including Standby Parts)
1/10 of 1¢ per Ton

There can be no better proof of American's superlative endurance and economy of operation!

**Typical Survey Results**

| LOCATION | CRUSHER | TONNAGE | PARTS REPLACEMENT COST |
|---|---|---|---|
| N. J. Central Station | 42-S | 6,000,000 Tons | $.00025 per ton, 20-year-old installation! |
| W. Va. Industrial Power Plant | 38-S | 10,008,000 Tons | $.0008 per ton. 10 years in service! |
| Illinois Coal Mine | AC3-E | 4,000,000 Tons | $.0005 per ton for 10 years service! |
| W. Va Coal Mine | 38-S | 2,514,000 Tons | $.0007 per ton, 23 years old! |
| Ill. Power Plant | 42-S | 2,950,000 Tons | $.0004 per ton, 6 years in service. |
| | | | $.000 per ton for 10 |

**. . . and for low-cost coal sample crushing**



Model 15 x 9 American Sample Crusher (one of several sizes) with capacities up to 2,000 lbs. per hr. Can be equipped with American Adjustable Sampling Hopper, for a 5%-10%-15% or 20% sample of a sample.

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**10,000 PSI**
*for water, oil or gas*

- Body and stem guide extra heavy bar stock fused into one piece.
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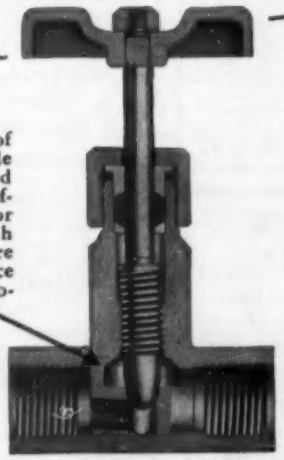
- Packing special one-piece "Marpak" moulded ring.
- Bodies marked in accordance with MSS regulations.



**ONE PIECE**

The stem guides of conventional needle valves are screwed into bodies—this often causes leakage or blow-outs. Marsh Needle Valves are fused into one-piece by exclusive "Conoweld" process.

# The Ultimate in Needle Valves

Here is one of the crowning achievements of Marsh research, design, and manufacturing skill. It is the first needle throttling and shutoff valve to combine *all* of the qualities called for today in this highly critical and ever broadening field.

It is a valve that has strength and safety to spare . . . rated for pressures up to 10,000 psi—equally efficient in the lower ranges. A product of Marsh instrument-making and valve manufacturing experience, it combines instrument-like precision with the ruggedness that distinguishes all Marsh valve specialties.

The illustrations tell the story of new thinking; new standards. Body and stem-guide are machined from extra-heavy carbon steel bar stock. Still greater strength and rigidity are achieved by fusing the stem-guide into the body. The complete fusion of guide and body is accomplished by the exclusive Marsh "Conoweld" process.

There are two big advantages to this one-piece construction: (1) It eliminates the danger of unscrewing the valve from the body when opening—a frequent cause of leakage, even dangerous blow-outs (2) It permits perfect line-up of threads and seat. As a result, Marsh valves are easier to operate even at high pressures.

The precision-machined stem is 416 stainless steel. Stem threads are fine pitch for extra strength and fine, controlled regulation. Notable advancements are special "Marpak" one-piece, non-binding longer-lasting packing; deep thread chambers, keeping inlet and outlet piping away from ports and contributing excellent flow characteristics. Entire packing nut and packing gland are electro-zinc plated, preventing corrosion and giving the valve a handsome, plated exterior. The rugged malleable handle is finished in heavy baked enamel.

The new needle valve line includes globe and angle patterns with double female connections in sizes ⅛", ¼", ⅜", ½", ¾" and 1". Also globe and angle valves with male inlet and female outlet in sizes ¼" and ½". *Complete stock carried at our Skokie, Illinois factory and also at our branch plant in Houston, Texas.*

**Write today for catalog giving complete details.**

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Export Dept., 3501 Howard St., Skokie, Ill.

# MARSH

"THE STANDARD OF ACCURACY"

# CLASSIFIED SEARCHLIGHT SECTION ADVERTISING

## EMPLOYMENT • BUSINESS • OPPORTUNITIES • EQUIPMENT—USED or RESALE

**UNDISPLAYED RATE**

$1.50 a line. Minimum 3 lines. To figure advance payment count 5 average words as a line. (See ¶ on Box Numbers.)

POSITION WANTED undisplayed rate is one-half of above rate, payable in advance.

PROPOSALS, $1.50 cents a line an insertion.

**INFORMATION**

BOX NUMBERS count one additional line in undisplayed ads.

DISCOUNT OF 10% if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

EQUIPMENT WANTED or FOR SALE Advertisements acceptable only in Displayed Style.

**DISPLAYED RATE**

The advertising rate is $16.25 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request. AN ADVERTISING INCH is measured ⅞ inch vertically on one column, 3 columns—30 inches—to a page. PR.

*NEW ADVERTISEMENTS, N. Y. Office, 330 W. 42nd St., N. Y., for the February issue closing January 8th.*

*REPLIES (Box No.):*
*Address to office nearest you*
*NEW YORK: 330 W. 42 St. (36)*
*CHICAGO: 520 N. Michigan Ave. (11)*
*SAN FRANCISCO: 68 Post St. (4)*

### SELLING OPPORTUNITY OFFERED

L°A Water Softener Co. seeks representatives in principal cities east of Mississippi. Starting aggressive expanded sale program with modernized line. Contact Howard Egginson, Eastern Divisional Manager, 225 W. 34th St., New York 1, N. Y.

### POSITIONS WANTED

CHIEF WATCH Engineer: 15 years power plant operation with one company—high and low pressure. Desire relocation in new or expanding plant with advancement possibilities. Married. 41 years of age—present salary $450 monthly. PW-4443, Power.

POWER PLANT Superintendent experienced in diesel and hydroelectric stations here and abroad, now employed in Colorado, seeks charge of diesel plant in East. Age 37. PW4793, Power.

### OFFICIAL PROPOSALS

**BIDS: February 3, 1955**

### PUMPS, GENERATING PLANT, SWITCHGEAR

Sealed bids for Furnishing and Delivering Pumps, Generating Plant, Switchgear and Appurtenances for Villa Montes Pumping Station, will be received by the Corporacion Boliviana de Fomento a Casilla, 1124 La Paz, Bolivia, South America, until 2:00 P.M. La Paz time on February 3, 1955 at which time the bids received in La Paz will be opened. Bidders are also required to send a copy of the bid for receipt not later than 1:00 P.M. New York time February 3, 1955, to Knappen-Tippetts-Abbett-McCarthy, Engineers at 62 West 47th Street, New York 36, New York, U.S.A.

The equipment to be furnished will include five vertical irrigation pumps; three diesel generating units complete with auxiliaries; switchgear; discharge piping; and miscellaneous equipment.

Contract documents including drawings and specifications may be examined at the above offices of the Corporacion Boliviana de Fomento and Knappen-Tippetts-Abbett-McCarthy, Engineers. Contract documents may be obtained upon deposit of fifteen dollars ($15.00) per complete set, which deposit will be refunded upon return of the set in good condition within twenty (20) days after date of opening of bids.

Each bid received at La Paz, must be accompanied by cash, certified check or bid bond in the amount of five percent (5%) of the total bid price.

## GET 2nd ENGINEER PAPERS IN 1 YEAR

*(Yes, get better stationary engineers License!)*

No correspondence school bother. Nationally-known Chief Stationary Engineer Frederick C. Walker's 100-Question, 100-Answer Bulletins give you the straight dope quick. Send $3 to Walker & Collins, 524 Ashland Ave., Buffalo 22, N. Y. for first set today. Keep working. Save year.

### MFR'S REPRESENTATIVES WANTED

Established manufacturer of chain grate stokers and dump grate spreader stokers is desirous of securing representatives in the following territories: New York, Western Pennsylvania, Ohio, Michigan, Wisconsin, Minnesota, North Dakota, South Dakota, Wyoming, Montana and Utah. Write full particulars of lines presently represented and territory covered.

**RW-4882, POWER**
**520 No. Michigan Ave., Chicago 11, Ill.**

### MECHANICAL DRAFTSMAN

Experienced in power plant piping. Write stating experience and salary desired. Location—Southeast. Write

**P-4917, POWER**
**330 W. 42 St., New York 36, N. Y.**

### MECHANICAL ENGINEERS

With 5 to 10 years experience in central station power plant design. Permanent position with fine opportunity for advancement. Write stating education, experience and salary desired. Location—Southeast. Write

**P-4920, POWER**
**330 W. 42 St., New York 36, N. Y.**

### LEFAX POCKET SIZE TECHNICAL DATA BOOKS $1.25 EACH

Printed on loose leaf, six hole, 6¾" x 3¾" bond paper each book contains about 140 pages of technical data, presenting condensed, accurate and essential data for the student, engineer, technical worker and businessman.

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|---|---|---|
| Architecture | Metals | Transformers, |
| Home Heating | Gen'l Chemistry | Relays, Meters |
| Illumination | Reinf. Concrete | Surveying |
| Electrician's Data | Building Constr. | Mech. Drawing |
| Builder's Data | Radio | Machine Design |
| Lumber Data | Television & FM | Machinist's Data |
| Air Conditioning | Electricity, AC | Piping Data |
| General Math. | Electricity, DC | Surveying Data |
| Math. Tables | AC Motors and | Tri-Log Tables |
| Physics | Generators | Metallurgy |
| Chemical Tables | Hydraulics | Analytic Chemistry |

Write for FREE Catalogs (over 2000 listings). See for yourself how helpful LEFAX can be to you. Send $1.25 for each book, or $6 for any five books listed.

**LEFAX DEPT. PO 6, PHILADELPHIA 7, PA.**

### LOOKING FOR A SALES AGENT?

POWER's new, 1954 "Directory of Manufacturer's Agents Serving the Power Field" lists over 2,000 sales agencies everywhere, with names, addresses and accounts. Price $10.

**POWER**
**330 W. 42 St., New York 36**

## WANTED

### DIESEL ELECTRIC UNITS

Needed Used Diesel Electric Units from 2500 K.W. to 5000 K.W. Sea level rating to generate at 2400/4160 volts three phase—60 cycles, history, prices, place & time of Delivery.

**Post Office Box 1324**
**New York 8, New York**

## WANTED

1—Good used steam vacuum pump, size 6"x 10"x12", suitable to take care of 26,000 ft. of radiation.

1—Used 12" Horizontal flanged exhaust steam Oil Separator

1—Used 12" Flanged Atmospheric relief valve, suitable for vertical mounting.

1—Used 12" Flanged exhaust head, large size preferred.

1—Used 8" Flanged exhaust head, large size preferred.

**Box #296, Gardiner, Montana**

## VOLTAGE REGULATOR

1—500 KVA Westinghouse Voltage Regulator, 34500 volts, 3 phase, type WR, class OA, serial 4089172, late type, perfect condition.

**UNITED SURPLUS, INC.**
**2433 Indiana Avenue**
**Chicago 16, Illinois**
**Telephone: Calumet 5-2688**

### FOR SALE

1—General Electric AC Turbine generator unit with condenser. 1875 KVA, 3 phase, 60 cycle, 2400 volts, 160 lbs.

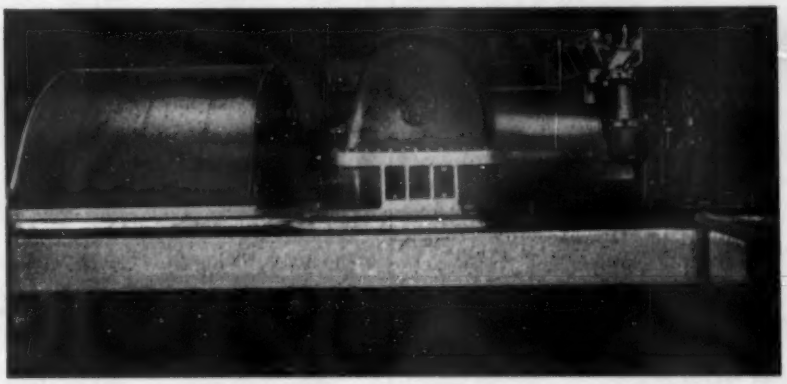
**MT. CARMEL PUBLIC UTILITY CO.**
**Mt. Carmel, Ill.**

### 1250 KW TURBOGENERATOR CONDENSING EXTRACTION

1250 KW 80% pf 1563 KVA General Electric, 165/300 lbs. pressure, 700 deg. FTT, 5/10 lbs. automatic extraction, 3 phase 60 cycle 480 v., 2000 sq. ft. surface condenser, auxiliaries and switchboard.

**OHIO POWER MACHINERY COMPANY**
**13661 Euclid Ave., Cleveland 12, Ohio**

# 3750 KVA.—A 400#, 750°F., VERY HIGH GRADE, GENERAL ELECTRIC TURBINE-GENERATOR. EXCELLENT CONDITION, WILL OPERATE UNIT WHEN INSPECTED. IMMEDIATE DELIVERY.



**The Above Cut shows our 3750-KVA., General Electric, Condensing, 400#, Turbine-Generator. Unit is complete with all Accessories, including 2-Pass Surface Condenser, Switchboard with Instruments, Direct Connected Exciter, etc., etc. Voltage 3/60/2300-4160-V. If desired, will operate unit when inspected.**

**WE DEAL EXCLUSIVELY IN TURBINE SETS, DIESEL POWER, BOILERS.**

**OUR STOCKS RIGHT NOW ARE VERY LARGE: MANY OF THE BEST MACHINES WE HAVE EVER OWNED AND OFFERED ARE NOW IN OUR STOCKS. INVESTIGATE.**

***HERE ARE A FEW OF OUR TURBINE-GENERATORS NOW IN STOCK:***

1—2000 KW Gen. Elect. Cond.—440#—750° F.T.T.—2300 V.
1—2000 KW Al.-Chal. Cond.—400#—750° F.T.T.—2300 V.
1—1500 KW Gen. Elect. Cond.—410#—750° F.T.T.—2300/4160 V.
1—2000 KW West., Non-cond.—250#—600° F.T.T.—40# B.P., 2300 V.
1—1250 KW West., Non-cond.—150#—600° F.T.T.—15# B.P., 2300 V.
1—1250 KW Gen. Elect., Non-cond.—200#—600° F.T.T.—15# B.P., 480 V.
2— 750 KW West., Non-cond.—150#—600° F.T.T.—15# B.P., 2300 V.
1— 500 KW Gen. Elect., Non-cond., 150#, 600° F., 15#, BP., 480-V. NEW.
1— 500 KW. West. Non-cond., 150#, 600° F., 15#, BP., 480-V.

**PHOTOS., DRAWINGS, COMPLETE DATA ARE YOURS FOR THE ASKING**

***WE INVITE CORRESPONDENCE. INVESTIGATE OUR OFFERINGS.***

## CHARLES WEAVER, M. E.

**4145 PENOBSCOT BUILDING**
**DETROIT 26, MICHIGAN**

***ANYTHING — EVERYTHING FOR THE POWER PLANT OUR MOTTO.***

# GET FULL VALUE FOR EVERY EQUIPMENT DOLLAR

## with CHICAGO ELECTRIC GUARANTEED "REBUILTS"

WIRE WRITE OR PHONE CAnal 6-2900

**POWER EQUIPMENT FOR ALL INDUSTRIAL NEEDS**

CHICAGO ELECTRIC's modern plant houses one of the nation's largest stocks of guaranteed rebuilt power equipment; to

- AC & DC MOTORS
- GENERATORS
- M.G. SETS
- FREQUENCY CHANGERS
- ROTARY CONVERTERS
- VARI-VOLT DRIVES
- ENGINE GENERATORS
- TRANSFORMERS
- CONTROLS

also a big selection of allied equipment such as HOISTS, CRANES, AIR COMPRESSORS, FANS, BLOWERS, REDUCERS, BOILERS and PUMPS . . . so, whatever you need and whenever you need it . . . be sure to check with CHICAGO ELECTRIC first!

### SYNCHRONOUS MOTORS

3 phase, 60 cycle, 220 or 440 volt (*2300 volts or higher)

| H.P. | Make | Type | Power Factor | Speed |
|---|---|---|---|---|
| 1620 | *Westg. | | 1.0 | 900 |
| 750 | *Westg. | | 1.0 | 900 |
| 710 | *G.E. | ATI | 1.0 | 720 |
| 600 | *G.E. | TH-7640 | 1.0 | 900 |
| 500 | *G.E. | TH-7657 | 1.0 | 514 |
| 400 | *Westg. | H | .8 | 1800 |
| 400 | Westg. | HG | 1.0 | 900 |
| 300 | G.E. | ATI | .8 | 900 |
| 300 | G.E. | ATI | .8 | 720 |
| 300 | *Ideal | SMM | .8 | 257 |
| 200 | G.E. | ATI | .8 | 1200 |
| 250 | G.E. New | TH-974T | .8 (2brg) | 720 |
| 225 | G.E. | TH-8244 | 1.0 | 300 |
| 225 | El. Mch. | | 1.0 | 360 |
| 200 | F-M | TJC-285 | .8 | 720 |
| 100 | El. Mch. | | 1.0 | 720 |
| 150 | F-M | TJC-286 | .8 | 720 |
| 150 | G.E. | ATI | .8 | 720 |
| 150 | *El. Mch. | | .8 | 1200 |
| 150 | Westg. | HR | 1.0 | 300 |
| 125 | *G.E. | TH-7641 | 1.0 | 514 |
| 125 | *G.E. | TH-8214 | 1.0 | 277 |
| 125 | *El. Mch. | | | 990 |

### D. C. MOTORS—230 Volt

| H.P. | Make | Type | Speed |
|---|---|---|---|
| 350 | Westg. | 8K-220 | 450/600 |
| 250 | Westg. | 8K-201 | 600 |
| 200 | Cr. Wh. | CM | 600 |
| 175 | G.E. | ELC | 750 |
| 150 | G.E. | MFC | 400/800 |
| 100 | G.E. | BC-34 | 2500 |
| 100 | G.E. | CDP-115 | 1750 |
| 100 | G.E. | BC-19 | 575 |
| 100/150 | G.E. | MCF | 350/1000 |
| 75 | G.E. | RCP-54 | 1750 |
| 50/120 | G.E. | MCF | 350/1000 |
| 50 | G.E. | BC-31B | 1700 |
| 50 | Cr. Wh. | CMC | 700/1100 |
| 50 | G.E. | DLC-504 | 650 |
| 35 | Westg. | 8K-156 | 350/1000 |
| 30 | Cr. Wh. | CCM-504 | 650 |
| 30/40 | G.E. | CD-115 | 500/1800 |
| 25 | G.E. | BC-21 | 800 |

### SLIP RING MOTORS

3 phase, 60 cycle, 220 or 440 volts (*2300 volts or higher)

| H.P. | Make | Type | Speed |
|---|---|---|---|
| 1500 | *G.E. | MT-50 | 240 |
| 1250 | *Westg. | CW | 300 |
| 1000 | *Westg. | CW | 250 |
| 700 | *Al-Ch. | ANY | 720 |
| 600 | G.E. | MT-567 | 1800 |
| 600 | *Westg. | CW | 450 |
| 600 | *G.E. | I-P | 257 |
| 500 | Westg. | CW | 350 |
| 400 | Al-Ch. | 3 brg. | 450 |
| 400 | *G.E. | MT-412 | 450 |
| 300 | *G.E. | IE-15A | 1900 |
| 300 | *G.E. | MT-568 | 720 |
| 250 | Westg. | HF-15H | 600 |
| 200 | *Westg. | CW | 1200 |
| 200 | G.E. | IK-15B | 900 |
| 200 | G.E. | IM | 600 |
| 150 | Cr. Wh. | 50-R | 1800 |
| 150 | G.E. | MT-549 | 1800 |
| 150 | *Al-Ch. | ANY-20F1 | 1200 |
| 150 | Westg. | CW-868A | 720 |
| 125 | G.E. | IM-15A | 600 |
| 100 | G.E. | IT-13A | 1800 |
| 100 | G.E. | IM | 600 |
| 100 | G.E. | IM | 450 |
| 75 | Nor. West. | HW-50 | 1800 |
| 75 | G.E. | MT-347 | 1200 |
| 75 | G.E. | IM | 1200 |
| 75 | Al-Ch. | ARY-223C | 1200 |
| 75 | G.E. | MT-356 | 900 |
| 75 | Al-Ch. | ANY-20F | 900 |

### SLIP RING MOTORS

Crane and Hoist Service
3 phase, 60 cycle, 220 or 440 volt

| H.P. | Make | Type | Speed |
|---|---|---|---|
| 75 | Westg. | CL-754A | 600 |
| 50 | Westg. | MW-524 | 600 |
| 50 | G.E. | HIC TENV | 600 |
| 35 | G.E. | MTC-5536 | 600 |
| 22 | G.E. | ITC-5000 | 1200 |
| 20 | Westg. | C1 | 1200 |
| 15 | G.E. | ITC-5010 | 720 |
| 11 | Westg. | C1-E464 | 900 |
| 10 | P & H | BW-6 | 1800 |

### MOTOR GENERATOR SETS

| K.W. | Make | | |
|---|---|---|---|
| 1000 (3u) | Westg. | 11000 | 137/275 |
| 500 | Westg. | 2300 A.C. | 137/275 D.C. |
| 500 | Westg. | 2300 | 275 |
| 400 | A.C. | 2300 | 120/240 |
| 300 | G.E. | 2300 | 250 |
| 300 | G.E. | 2300 | 250 |
| 200 | Westg. | 4160 | 250 |
| 200 | Ridgeway | 2300 | 250 |
| 170 | G.E. | 440 | 125 |
| 150 | G.E. | 2300 | 125/250 |
| 150 | G.E. | 4000 | 250 |
| 150 | A.C. | 2300 | 275 |
| 150 | G.E. | 440 | 275 |
| 100 | Westg. | 440 | 125 |
| 100 | El. Mch. | 440 | 125 |
| 100 | G.E. | 240 | 230 |
| 100 | G.E. | 440 | 125 |
| 90 | G.E. | 447 | 480 |
| 75 | G.E. | 440 | 125 |
| 60 | Westg. | 2300 | 125 |
| 60 | A.C. | 2300 | 125 |
| 50 | Reliance | 440 | 250 |
| 50 | Ideal | 2300 | 250 |
| 50 | Westg. | 240 | 125 |
| 40 | G.E. | 440 | 125 |
| 40 | G.E. | 440 | 250 |
| 25 | Westg. | 2300 | 150 |
| 20 | G.E. | 440 | 125 |
| 30 | Westg. | 2200 | 125 |
| 25 | L-Allis | 440 | 250 |
| 20 | Bogue-GE | 550 | 250 |
| 20 | Bogue-GE | 220/440 | 250 |
| 20 | Bogue-GE | 440 | 125 |
| 15 | Westg. | 220/440 | 250 |

### PUNCH PRESS MOTORS

NEW—3/60/220-440 volt
High Torque—High Slip

| H.P. | Make | Type | Speed |
|---|---|---|---|
| 60/45 | G.E. | KK-6325 | 1000/750 |
| 60 | Westg. | CH-752-C | 1060 |
| 60 | Westg. | CH-857-C | 1585 |
| 50 | Westg. | CH-505 | 1080 |
| 50 | Imperial | E-1584 | 1080 |
| 40 | Reliance | AA-B-505 | 1635 |
| 40 | Imperial | E-505 | 1080 |

**CHICAGO** *Electric Co.* 1320 WEST CERMAK ROAD, CHICAGO 8, ILL.

*Need Air?*

**CALL AMERICAN AIR OF JERSEY**

**AIR FOR SALE OR RENT**

SINCE 1902

GAS • DIESEL • STEAM • ELECTRIC

NEW AND QUALITY REBUILTS

**STATIONARY**

40.6 CFM 5500 psi 3 stage Ingersoll Rand 25 HP Elec
122 CFM 100 psi 7x7 Worthington HB 20 HP Elec
125 CFM 100 psi 6½x4½ Davey VB6 6 available
143 CFM 125 psi 6/8/5x5 Worth M-25 25 HP Elec
204 CFM 125 psi 10x10 Ingersoll ER-1 40 HP Elec
218 CFM 500 psi 10x4½x10 Ingersoll XCB 75 HP Synchronous
270 CFM 125 psi Joy WL-80 2 available
278 CFM 125 psi 2 Stage Chicago PB 50 HP Elec.
295 CFM 125 psi 2 Stage Gardner "WD" 50 HP Elec
300 CFM 100 psi 5 cylinder Davey 50 HP Elec
301 CFM 140 psi 5 cylinder Ingersoll Type 40 2 Available
304 CFM 125 psi 10x11 Chicago T-B 2 available
312 CFM 100 psi 4 cylinder Gardner "AAG" 60 HP Elec
343 CFM 500 psi 11/8x13 Worthington HB2 Elec or steam
364 CFM 120 psi 12x7 Gardner "RX" 2 Available
435 CFM 100 "Unitair" Joy WL-60 75 HP Elec
552 CFM 125 13/8x10 Ingersoll 100 HP Elec
560 CFM 125 psi 2 stage Chicago PB6 100 HP Elec.
782 CFM 110 psi 10½/9 ¾x10 Worth DC-2 125 HP Elec
931 CFM 50 psi 17x13 Chicago T-B Steam or Electric
1065 CFM 35 psi 20x12 Penn 3-A 100 HP Elec
1574 CFM 100 psi 22/14x16 Ingersoll PRE-2 3 available
1575 CFM 50 psi 15/15x14 Penn DB-1 200 HP Elec
1725 CFM 110 psi "XPV" 4 corner Ingersoll Steam

PORTABLE— 15 CFM to 600 CFM
VACUUM PUMPS— 3 CFM to 5681 CFM
SPECIAL— Compressors for special air applications and conditions
DELIVERIES— Always prompt.

*American*
AIR COMPRESSOR CORP
BELL AVE. & 47th ST.
NORTH BERGEN, N.J.
Telephone UNion 5-6848

Do you need a

**250 H.P. LOW PRESSURE BOILER?**

**?**

Cliff Steel, Built Terra Haute, Ind., 1946 —used 5 years (in fine condition) Horizontal Fire Tube, Complete with Petro Oil Burner (#6 fuel oil) 48" Stack Fan and 35' Stack; Protector Relays and Controls; Ignition Transformer Pump, Oil Valves. Boiler and Equipment originally cost $15,000.00.

First **$5,000.00** takes it.

For further details and arrangements for inspection please contact G. G. Hengst at Fairchild Aircraft Division, Hagerstown, Maryland.

ENGINE AND AIRPLANE CORPORATION
**FAIRCHILD**
*Aircraft Division*
HAGERSTOWN, MARYLAND

**FOR SALE**

**18 NEW TURBINES**

**4 horizontal, 14 vertical, Westinghouse**

Driving forced draft blowers—capacities ranging from 39000 to 56000 CFM and 16" to 24" pressure. Steam pressures 360 to 575#, back pressure 10#.

Will sell turbines separately if desired. *Price reasonable.*

*Also*—1—250 KW GE turbo generator unit, 3 phase, 60 cycle, 440 volt. Used one year.

**G. M. DeROSE**
2457 WOODWARD AVE.
408 DONOVAN BLDG.
DETROIT 1, MICH.

2—333 KVA—1-60-33000 to 2300/4000 V. General Electric outdoor transformers.
4—100 KVA-3-60-2400-120/208 V. Pyranol transformers each with 275 A, 600 V. 3 pole air breaker.
1—150 HP-900 rpm-440-3-60 GE synchronous motor exciter and automatic starter.
1—100 HP-870 rpm-440-3-60 NEW Elec. Mach. Mfg. Co. Magnetic Drive and Regutron Control.
H. BLAINE JOHNSON & ASSN.
53 W. Jackson Blvd. Chicago 4, Ill.

**NEW UNUSED**

**1000 KVA CONDENSING TURBINE GENERATOR**

1000 KVA—750 KW, 75% PF, General Electric alternating current generator, 3 phase 60 cycle, 450 volt, 1200 RPM connected through reduction gear to a:

750 KW General Electric condensing steam turbine, 10033 RPM, 375-440#, 740°TT.

**UTILITIES MACHINERY CORP.**
1965 E. SIXTH ST., CLEVELAND 14, OHIO

# There's more than 40% to 60% SAVINGS on

## SCHOONMAKER DEPENDABLE DIESEL POWER

## because:

Each Schoonmaker-sold Diesel Engine Unit is fully RE-MANUFACTURED in our plants by highly skilled, factory-trained Diesel engineers. Only genuine factory-made and approved parts are used and all REMANUFACTURING is in strict accordance with manufacturer's recommended procedures. Prior to shipment every engine is subjected to a FULL LOAD operating test in accordance with DEMA standards.

The Schoonmaker Plants and Warehouses located in Eddystone, Penna. and Sausalito (San Francisco), California give NATIONWIDE SERVICE from Coast to Coast with modern, efficient and reliable facilities.

Our reputation and many years of experience and SPECIALIZATION in Diesel power equipment gives you value that money cannot buy elsewhere.

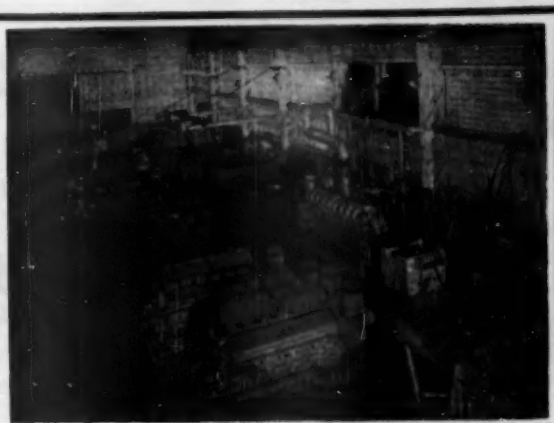
So—Buy SCHOONMAKER because you buy the FINEST in DEPENDABLE DIESEL POWER.

*America's largest source of New and Remanufactured Diesel Power*

A.G. SCHOONMAKER CO., INC.

**50 CHURCH ST., NEW YORK 7, N. Y.**

PLANTS AND WAREHOUSES:
EDDYSTONE, PENNA. AND SAUSALITO (S.F.), CALIFORNIA



PORTION OF ENGINE REMANUFACTURING FLOOR AND ONE OF THE ENGINE TEST STANDS AT OUR SAUSALITO, CALIF. PLANT

### A PARTIAL LIST OF OUR INVENTORY

| KW | MAKE | MODEL | HP | RPM |
|---|---|---|---|---|
| 1180 | Worthington | SEH-8 | 1685 | 360 |
| 1136 | Fairbanks Morse | 38D | 1600 | 720 |
| 1100 | General Motors | 16-278A | 1600 | 720 |
| 750 | General Motors | 12-567 | 1080 | 720 |
| 700 | Worthington | EE-8 | 1000 | 327 |
| 600 | General Motors | 12-567 | 900 | 600 |
| *500 | Alco | 6-12½x13T | 750 | 600 |
| 500 | General Motors | 8-567 | 720 | 720 |
| *350 | Baldwin | VO-6 | 510 | 450 |
| 320 | Superior | 60-S-6 | 460 | 450 |
| *320 | Enterprise | DSG-6 | 460 | 450 |
| 300 | General Motors | 8-268A | 450 | 1200 |
| 200 | General Motors | 8-268A | 350 | 900 |
| *160 | Buckeye | 80 | 240 | 600 |
| *150 | Worthington | CC-4 | 225 | 450 |
| 148 | Fairbanks Morse | 32E14 | 225 | 300 |
| 100 | General Motors | 3-268A | 150 | 1200 |
| 60 | General Motors | 6-71 | 90 | 1200 |

ALTERNATING AND DIRECT CURRENT UNITS
STANDARD AND SPECIAL VOLTAGES AS REQUIRED
*—*indicates NEW unit*

ONE YEAR GUARANTEE!

## BOILERS

9—304 HP, Kewanee, Firebox, Model 590, 125 PSI, ASME with soot blowers.
4—150 HP, Casey Hedges, HRT, 150 PSI, ASME, gas fired.
1—50 HP, Titusville, 150 PSI, adaptable gas or oil firing.

**HEAT & POWER CO., INC.**
70 Pine St., New York 5, N. Y.
HAnover 2-4890

## BREW WOLTMAN *Offers*—

Many years experience and service in POWER EQUIPMENT
*—Specializing In*

| | | |
|---|---|---|
| Turbo Units | Steam Engine Units | Synchronous Condensers |
| Diesels | Rotary Converters | Synch. & Ind. Motors |
| Boilers | Motor Generator Sets | Oil & Air Circuit Breakers |
| Transformers | Frequency Changers | Feeder Voltage Regulators |

*Your inquiries stating your needs will receive our careful and prompt attention*

**BREW, WOLTMAN & CO., INC., 50 Church St., New York 7**

## 1000 KW NON-CONDENSING TURBINE GENERATOR

1250 KVA—1000 KW, 80% PF, General Electric alternating current generator, 3 phase 60 cycle, 2300/480 volt, 3600 RPM, direct connected to a:

1000 KW General Electric non-condensing steam turbine, 125-150#, 10-15# gauge back pressure.

Direct connected exciter, switchboard, instruments and spare parts.

**UTILITIES MACHINERY CORP.**
1965 E. SIXTH ST., CLEVELAND 14, OHIO

## —TRANSFORMERS—

### BOUGHT AND SOLD

We carry a large stock of rebuilt and guaranteed transformers and invite your inquiries.

Custom-built transformers and coils manufactured to your specifications.

Expert Repair Service—all makes and sizes of transformers rewound, repaired and redesigned. Ask for our price schedule.

**THE ELECTRIC SERVICE CO., INC.**
5331 Hetzel St. Cincinnati 27, Ohio
*40 Years' Dependable Service*

# STOP SEARCHING!

***QUALITY and ECONOMY are quickly found in***

# HEMPHILL *Guaranteed* EQUIPMENT

**NEW COMPLETE OUTDOOR SUBSTATION**

2—3750 KVA, G.E. type OA, 4687 KVA forced air, 26400 volts pri., 5 taps above and below, 4160/2520 volts sec. with fans, steel structure, outdoor, 1-million KVA interrupting breaker, etc. Purchased 1951, never used.

**TRANSFORMERS 60 CYCLE**

| Qu | KVA | Make | Type | PH. | Voltages |
|---|---|---|---|---|---|
| 2 | 3750 | G.E. New | OI8C | 3 | 26400x4160 |
| 1 | 1000 | G.E. | Auto | 3 | 4150x2400 |
| 1 | 1000 | Amer. | OI8C | 3 | 4150x480 |
| 1 | 750 | G.E. | HT | 3 | 4150x120/240 |
| 1 | 750 | G.E. | H | 1 | 4600x120/240 |
| 1 | 500 | Kuhl | OI8C | 3 | 4600x2300 |
| 1 | 400 | Pitts. | OI8C | 1 | 4150x240/480 |
| 1 | 333 | G.E. | H | 1 | 13200x220/440 |
| 1 | 200 | G.E. | H | 1 | 13200x440 |
| 1 | 200 | G.E. | HT | 3 | 2400x240 |
| 1 | 200 | G.E. | H | 3 | 4150x2400V |
| 2 | 150 | Pitts. | ODSC | 1 | 230x115/230 |
| 3 | 100 | Wagner | HEB | 1 | 440x120/240 |
| 1 | 50 | Whse. | S | 1 | 2400x120/240 |
| 1 | 50 | Amer. | OI8C | 1 | 13200x220/440 |
| 3 | 50 | G.E. | H | 1 | 440x110/220 |
| 1 | 50 | Whse. | S | 1 | 2400x240/480 |
| 3 | 50 | G.E. | H | 1 | 2300x115/230 |
| 1 | 50 | G.E. | H | 1 | 2300x110/220 |
| 1 | 37½ | G.E. | H | 1 | 2400x120/240 |
| 1 | 37½ | G.E. | H | 1 | 13800x230/460 |
| 1 | 25 | Niagara | OI8C | 1 | 4160Yx480 |
| 1 | 20 | Moloney | HE | 1 | 2300x115/230 |
| 1 | 25 | Whse. | VB | 1 | 2400x240/480 |
| 1 | 25 | Allis | F18B | 1 | 480x120/240 |
| 1 | 10 | Packard | A | 1 | 600x110 |
| 1 | 10 | G.E. | H | 1 | 230/440x110/220 |

**MOTOR GENERATOR SETS**

| Qu | KW | Make | Speed | DC | AC |
|---|---|---|---|---|---|
| 1 | 1000 | G.E. | 514 | 600 | 2300/4150 3yn |
| 1 | 1000 | Whse. | 720 | 600 | 2300/4150 3yn |
| 1 | 1000 | Whse. | 720 | 275 | 2300/4150 3yn |
| 1 | 300 | G.E. | 1200 | 250 | 2300/4150 3R |
| 1 | 300 | G.E. | 1200 | 250 | 2300/4150 3yn |
| 1 | 200 | Whse. | 900 | 120 | 2300/4150 3yn |
| 1 | 150 | G.E. | 1200 | 125/250 | 2300 3yn |
| | | | | 3 unit | |
| 1 | 100 | G.E. | 900 | 250 | 2300 3yn |
| 1 | 97 | G.E. | 1200 | 60 | 4150 3yn |
| 1 | 75 | G.E. | 1800 | 250 | 220/440 3C |
| 1 | 60 | Whse. | 1200 | 60 | 2300 V |
| 1 | 60 | EM | 1500 | 125 | 220 |
| 1 | 30 | Whse. | 900 | 250 | 440 |
| 3 | 30 | G.E. | 1750 | 240 | 220/440 |
| 1 | 25 | G.E. | 1800 | 250 | 230 V 3yn |
| 1 | 20 | EM | 1900 | 125 | 230 V |
| | 7½ | Allis | 1800 | 125 | 220/440 |
| 1 | 0 | G.E. | 1800 | 125 | 220/440 |
| 3 | 1½ | G.E. | 3466 | 500 cy | 220/440 |
| | | | | 1 ph | |

**SYNCHRONOUS MOTORS**

| QU | HP | Make | Speed | Type | Volts |
|---|---|---|---|---|---|
| 1 | 500 | Whse. | 450 | HR | 2300 |
| 1 | 400 | Whse. | 450 | HR | 550 |
| 1 | 350 | Whse. | 450 | HR | 440 |
| 1 | 300 | EM | 720 | TEFC | 2300 |
| 1 | 300 | G.E. | 600 | ATI | 600 |
| 1 | 200 | Whse. | 600 | ATI | 240 |
| 1 | 175 | G.E. | 720 | AT3 | 2300 |
| 3 | 150 | G.E. | 1200 | T8 | 4150 |
| 1 | 150 | G.E. | 1800 | T8 | 220 |
| 1 | 150 | Whse. | 900 | 18IG | 220 |
| 2 | 150 | Allis | 360 | | 2300 |
| 1 | 125 | EM | 900 | | 4600 |
| 1 | 100 | G.E. | 900 | T8 | 2300 |

**SLIP RING MOTORS**

| QU | HP | Make | Speed | Type | Volts |
|---|---|---|---|---|---|
| 1 | 500 | G.E. | 1200 | M | 2400/4150 |
| 1 | 400 | Whse. | 450 | CW | 550 |
| 1 | 250 | Whse. | 60 | CW | 440 |
| 2 | 200 | Whse. | 600 | CW | 440 |
| 1 | 200 | G.E. | 600 | MT | 440 |
| 1 | 150 | A.C. | 1800 | AY RW | 2300 |
| 1 | 100 | G.E. | 1800 | IM | 220 |
| 1 | 100 | G.E. | 600 | IM | 440 |
| 1 | 75 | G.E. | 600 | IM | 440 |
| 3 | 60 | G.E. | 1800 | MT | 220 |
| 1 | 60 | G.E. | 900 | MT 546 | 440 |
| 2 | 50 | G.E. | 1800 | MT527 | 220/440 |
| 1 | 50 | G.E. | 1200 | MT536 | 220/440 |
| 2 | 50 | Whse. | 900 | CW | 220/440 |
| 2 | 50 | G.E. | 600 | MT | 220/440 |

**DC, 230 VOLT MOTORS**

| Qu | HP | Make | Speed | Type |
|---|---|---|---|---|
| 1 | 300 | G.E. | 1200 | MPC |
| 2 | 150 | C.W. | 900 | WP |
| 1 | 125 | G.E. | 1700 | BC |
| 2 | 75 | C.W. | 900 | WP |
| 1 | 30 | C.W. | 700 | CM |
| 1 | 25 | G.E. | 890 | BC |
| 1 | 25 | Whse. | 835 | SK |

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FOR POWER
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*Member of The National Industrial Service Association, Inc.*

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## DIESEL GENERATOR SETS

3—1400 HP Superior 8 cyl. 360 RPM 1000 KW Elec. Mchy. 3/60/2400 volt generators. Complete Plant. New 1949.

1—750 HP Superior 8 cylinder, 400 RPM, 500 KW Elec. Mchy. 3/60/2400 volt generator & auxiliaries.

1—400 HP Superior 4 cyl. 400 RPM Model VDSE, 250 KW, 3/60/2400 volt.

**MISSISSIPPI VALLEY EQUIPMENT CO**
**507 Locust St. St. Louis 1, Mo.**

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## 30 TON BRIDGE CRANE

65 ft. span—Northern Engineering Co. Fish belly fabricated—travel motor—trolley motor—30 ton hoist—15 ton auxiliary hoist motor. All 230 volt DC motors—mfg. by G.E.—cab controlled with G.E. controls. Can be seen in operation.

***IMMEDIATE DELIVERY***

**THE BOSTON METALS CO.**
**313 E. Baltimore Street**
**Baltimore 2, Md.**
**Curtis 7-5050**

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**DIESEL GENERATOR SETS**

100 KW General Motors Model 3-268A, A.C. & D.C. units. Rebuilt.
60 KW G.M. Model 6-71. Rebuilt.
Various makes and size in stock A.C. & D.C. units.

**ALJON ELEC. DIESEL CO.**
904 Pacific St. Brooklyn 38, N.Y.
STerling 3-6815

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## M-G SETS!

1—500 KW, 240 V. DC, Whse, M-G Set, 900 RPM, Syn. Drive, 3/60/230, Ser. 4979926, w. magnetic reduced voltage starter.

3—405 KW, 270 V. D.C., G.E. M-G Sets, 900 RPM, ATI Sync. Drive, 3/60/2300 Ser. 4093425.

**TURBO GENERATOR**

1—750 KW, Elliott, condensing, 200 PSIG, 112° superheat, 29" vac., 3/60/480—modern.

**SYNCHRONOUS MOTORS**

1—200 HP, F-M, 200 RPM, Type TZO, Fr. 5 440 volt

1—150 HP, G.E. 277 RPM, Type ATI, 2300 volt, w/C-H mag. clutch

1—125 HP, E-M, 600 RPM, Type BRKT Fr. 4, 2200 or 220/440 volt.

**NEW PUMPS**

2—1000 GPM, 425' TDH, DeLaval centrifugal pumps, type 2K8S/4 with 150 HP, 1760 RPM, Allis-Chalmers, splash-proof motors, 3/60/2300.

## MOTORS!

| Amt. | HP | Speed | Make | Type | Frame |
|---|---|---|---|---|---|
| 3 | 250 | 600 | G.E. | KT568 (2200V) | |
| 1 | 200 | 900 | A-C | AR830D | |
| 1 | 150 | 1800 | Whse. | C8(2200V) | 871S |
| 2 | 150 | 1800 | A-C | 26F-220-43-10 | |
| 2 | 150 | 1800 | A-C | AWW | 23B86 |
| 1 | 150 | 900 | G.E. | I-K (2200V) | |
| 1 | 125 | 1200 | Wag. | 26WBP | |
| 1 | 125 | 1800 | Whse. | C8 | 4 MIL. |
| 1 | 100 | 1800 | Howell | K (TEFC) | |
| 1 | 100 | 1800 | Whse. | C8 | 663C |
| 1 | 100 | 1200 | Whse. | C8 | 752C |
| 1 | 100 | 1200 | A-C | AR(2200V) | 823E |
| 1 | 100 | 900 | A-C | 2300 V 2K20664.1 | |
| 1 | 50 | 1720/575 | L-A | Adjusto-Speed | 445 |

**SLIPRING**

| | | | | | |
|---|---|---|---|---|---|
| 1 | 100 | 900 | G.E. | MT356 | |
| 1 | 100 | 450 | G.E. | I-M (2200V) | 16 |
| 2 | 75 | 720 | A-C | (1-2200V), 1-440V | |
| 2 | 75 | 900 | G.E. | I-M | |

*PARTIAL LISTINGS—10,000 OTHER MOTORS IN STOCK—NEW & REBUILT—A.C. & D.C.*
*NEW MOTORS AT LONG DISCOUNTS*

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**1704 North 8th St. Phone GArfield 1-4290 St. Louis 6, Missouri**

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APPARATUS EXCHANGE Two Rector St., New York 6, N. Y.

# O'Brien Offers—

## MOTOR GENERATOR SETS

1—500 KW Crocker Wheeler CCD, 250 volt 720 RPM with 750 KVA Cr. Wh. Syn. Motor 3/60/2300 V. A.C. & D.C. Panels.
1—300 KW GE—MPC—230 V. 1200 rpm, 435 Syn. 3/60/2400 V.
1—300 KW West. 3 wire 125/250 Volt 1200 RPM Generator (1938 year). Can furnish with suitable motor. Advise Requirement.
2—250 KW Burke 125 V. 435 KVA Syn. M.D. 3/60—any voltage
1—150 KW G.E. Type MPC—250 Volt 1200 RPM 3/60/2300/200 H.P. Syn. Motor Drive A.C. & D.C. Panels
1—100 KW G.E. RC 17, 125 v. 3/60/220/1200 rpm
1—100 KW Al. Ch. 250 V. 1200 RPM 150 HP. Syn. Mtr. 2/60 or 3/60 any voltage.
1—100 KW West SK Comp'd 125 V., 150 HP West syn. 3/60/440/1200 rpm.
1—75 KW Burke 250 V. 900 RPM 113 H.P. Burke—Syn. M.D. 2 or 3 ph. any voltage.
2—70 KW Century, 1000 amp, 70 volt, 3/60/220/440
1—62½ KW 125 volt Hertner, 1200 rpm, 100 HP Sq. Cg. 3/60/220
2—50 KW G.E.—CD-105—250 V. 75 HP KT 537—3/60/440
1—6 KW G.E. 6 v. 100 amp. 3/60/220
1—4000 Amp. 10 volt H.V.W. 600 rpm, 50 HP Syn. M.D. 3/60/220
1—2500 Amp 12 V. H.V.W. 600 rpm, 50 HP Syn. M.D. 3/60/220

## DIESEL GENERATOR SETS

2—625 KVA Inger. Rand, 3/60/480/720 rpm
2—438 KVA GM-Winton 3/60/2300/360 rpm
375 KVA GM 8-268 Diesel 3/60/440
2—312 KVA Worth. CC-6, 3/60/220/450 rpm
300 KW GM 8-268 Die el 125/250 V. D.C.
187 KVA GM Twin Diesel 3/60/220 New
100 KVA Murphy Diesel 3/60/220-440
56 KVA Climax Gas 3/60/220
30 KVA LeRoi Gas 3/60/220
45 KVA Chrysler Diesel 3/60/220
25 KVA LeRoi Gas 1/60/120/240
1—10 KW Wincharger 1/60/110-220 Gasoline

## BOILERS

1—60,000# Erie Stoker New 160 psi
1—500 HP Cleaver Package 200 psi, New, 1953—never used
1—350 HP Cleaver Package 150 Lb.—1942
1—300 HP Keeler CP—300 Lb. Stoker—1950
2—250 HP Keeler Type CP-160 Lb.—1948
1—250 HP Ames Package Type (1948) 150 psi
2—200 H Springfield Sec. H. dr. 400 psi
1—188 HP CP Keeler W.T. 1942 Oil 160 lb. W.P.
1—100 H Verticle Hand Fired 100 lbs. Working Pressure
1—100 HP Clayton Forced Recirculation Compact Self-Contained and Fully Equipped for Operation 160 lb. W.P.
1—35 HP O and S Scotch Hand Fired 100 lbs. W.P.
1—25 HP Dowtherm Vaporizer
5—18 HP Red-Line New Horizontal Oil Fired 150 lbs. W.P.

## ELECTRIC MOTORS

| QU. | HP | Make | Type | Volts | Speed |
|---|---|---|---|---|---|
| 1 | 500 | West. | CS | 6600/2300 | 514 |
| 1 | 450 | A.C. | ANY | 2300 | 600 |
| 1 | 400 | West. | CW | 440 | 514 |
| 1 | 400 | G.E. | Syn. | 2300 | 450 |
| 1 | 350 | G.E. | MT18 | 2300 | 400 |
| 2 | 200 | West. | CW | 2300 | 1800 |
| 1 | 200 | G.E. | I.M. | 440 | 514 |
| 1 | 150 | G.E. | I.M. | 440 | 600 |
| 1 | 150 | G.E. | K T | 440 | 600 |
| 1 | 125 | West. | Syn. 3 brg. | 550 | 600 |
| 1 | 100 | Al. Ch. | Sl. Rg. | 2200 | 900 |
| 1 | 100 | West. | CS | 440 | 1200 |
| 1 | 100 | West. | CW | 440 | 900 |
| 1 | 100 | G.E. | I.K. | 2200 | 1200 |
| 1 | 50 | G.E. | M T | 440 | 1200 |

## TURBO GENERATORS

1—11250 KVA G.E. 3/60/13200/3600 rpm—Condensing—Boilers—Complete Plant

2—4000 KVA Allis Chalmers 3/60/2300/3600 rpm—Condensing
1—1250 KVA DeLaval Non-Cond. 3/60/2300. New 1940 240 psi 50 lb. B.P.
1—938 KVA GE-Terry Aut. Extr. 3/60/480 150 psi. 20 lb. B.P. Surf. Condenser 1934
1—750 KVA G.E.-Moore 3/60/2300/3600 RPM Non-Cond. 180 PSI 35 lb. B.P. New 1936.
1—187 KVA West. Non-Cond. New 1930 3/60/440 110 psi 10 lb. B.P.
1—94 KVA Worthington Non-Cond. 3/60/220 140 psi 5 lb. B.P.
1—50 KVA 1200 rpm Century generator (New 1949) Dean Hill Non-condensing turbine
1—75 KW G.E. Non-Cond. D.C. 125 volt.

## AIR COMPRESSORS

1—1690 CFM Sullivan W. J. 3.22x15x16
1—1600 cfm IR PRE-2 Syn. Mtr. Dr. 3/60/2300—100 psi.
2—1300 cfm IR-PRE-2 3/60/2300—100 psi
1—978 CFM Sullivan 13x13x8, 45 psi.
1—670 CFM Chicago OCE Syn Mtr. Dr. 3/60/2300
1—396 CFM Sullivan WL60 125 psi Direct Drive 75 HP 3/60/440
1—368 CFM Chi. NSB. 12x10, 100 psi.
1—371 CFM Schramm 7¼x6x4, 100 psi
1—173 CFM Chicago N8B 100 psi

## OISC TRANSFORMERS

| Qu. | KVA | Make | Pri. V. | Sec. V. | Phase |
|---|---|---|---|---|---|
| 3 | 2000 | G.E. | 13200 | 230/460 | 1 |
| 3 | 1000 | GE | 13200 | 2300 | 1 |
| 1 | 1100 | West. | 4160 | 440 | 3 |
| 1 | 750 | O'Brien (New) | 13200 | 480 | 3 |
| 3 | 667 | Al. Ch. | 33000 | 2300 | 1 |
| 3 | 500 | West. Dry | 33000 | 2300 | 1 |
| 3 | 500 | West. | 22000 | 460 | 1 |
| 1 | 500 | Gregory | 4160 | 440 | 3 |
| 3 | 500 | GE | 13200 | 2300 | 1 |
| 3 | 400 | GE | 2400 | 480 | 1 |
| 3 | 333 | West. Dry | 2400 | 480 | 1 |
| 3 | 333 | West. (1945) | 33,000 | 480 | 1 |
| 3 | 333 | Pitts. | 33000 | 2300 | 1 |
| 3 | 333 | G.E. | 13800 | 240 480 | 1 |
| 3 | 250 | Al. Ch. | 13,200 | 115/230 | 1 |
| 2 | 250 | West. Dry | 13800 | 230 | 1 |
| 3 | 150 | West | 2300 | 230/115 | 1 |
| 3 | 150 | Dry | 2300/4160 | 230/460 | 1 |
| 3 | 100 | Dry | 2300/4160 | 230/460 | 1 |
| 3 | 100 | West. | 4160 | 240/480 | 1 |
| 3 | 85 | West. | 4160 | 120/240 | 1 |

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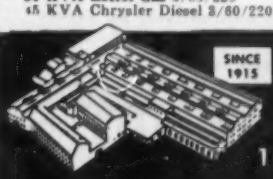

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## MOTOR GENERATOR SETS

1—150 KW, 275 V. D.C. G.E., 1200 RPM, Type MTC with synchronous drive, 3/60/2300-440, Ser. #3,940,286
1—300 KW, 125 V. D.C. W.H., 900 RPM, Type SK, with synchronous drive, 3/60/2300 Ser. #1855F751
1—125 KW, 150 V. D.C. W.H., 1200 RPM, Type SK153 with synchronous drive, 3/60/2300-440, Ser. #4,900,914, very late type.
2—35 KW, 125 V. D.C. G.E., 1200 RPM, Type CDM105, synchronous motor drive, 220/440/3/60, Type TS.

## PLATING AND ANODIZING

1—45 KW, 6/12 V, D.C., 400 RPM, Type N123, 5000/2500 Amp, Chandyssos synchronous drive, 220/440/3/60.
1—125 KW, 30 V, 4500 Amp, Ridgeway with 200 Hp synchronous motor drive, 220/440/3/60-720 RPM.

## BATTERY CHARGERS

1—18 KW, 30 V. 600 Amp, G.E. 1200 RPM, Type CD-103y, 1200 RPM, 30 HP, 220/440/3/60.
1—100 KW, 60 V, 1666 Amp, G.E., 900 RPM, 150 HP, S.C. Motor drive, 220/440/3/60

## MOTORS

| Qu. | HP | Make | Frame | RPM | Type |
|---|---|---|---|---|---|
| 8 | 150 | G.E. | 564-Open | 600 | KT, BB, Ped. Brg. |
| 1 | 100 | W.H. | Open | 720 | CS-SS |
| 1 | 100 | G.E. | 6326-TEFC | 900 | KS-XP |
| 1 | 400 | W.H. | Open-2300 | 900 | Sync. Ped. Brg. |
| 1 | 400 | Al. Ch. | Open-2300 | 1800 | S.R. |

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1017 Papin Street, St. Louis 2, Missouri

CHestnut 1-3110

# 37 Years Dependable Service

## SLIP RING MOTORS 3-Ph., 60 Cy.

| H.P. | Volts | Make | Speed |
|---|---|---|---|
| 600 | 2200 | Whse. | 450 |
| 500 | 2300/4000 | G. E. | 900 |
| 450 | 440 | Whse. | 514 |
| 450 | 440 | Whse. | 720 |
| 400 | 2200/440 | G. E. | 720 |
| 300 | 440 | G. E. (hoist) | 600 |
| 300 | 2200 | G. E. | 360 |
| 300 | 440 | Whse. | 3600 |
| 250 | 440/220 | Whse. | 600 |
| 250 | 550/440 | G. E. | 1200 |
| 200 | 440/220 | Whse. | 514 |
| 150 (2) | 440/220 | G. E. | 720 |
| 150 | 2200/440 | G. E. | 600 |
| 125 | 440/220 | G. E. (hoist) | 600 |
| 125 | 440/220 | G. E. | 900 |
| 125 | 550/440 | G. E. | 1200 |
| 125 | 2200 | G. E. | 600 |

## SYNCHRONOUS MOTORS 3-Ph., 60 Cy.

| H.P. | Volts | Make | Type | R.P.M. |
|---|---|---|---|---|
| 400 | 2200/440 | G. E. | ATI | 720 |
| 275 | 440/220 | Whse. | G | 900 |
| 350 | 440/220 | El. Machy. | Syn. | 1200 |
| 300 | 2300/400 | G. E. | T4 | 720 |
| 300 | 2200/440 | G. E. | T4 | 1200 |
| 250 | 2200/440 | G. E. | T4 | 720 |
| 250 | 440/220 | Whse. | HR | 277 |
| 250 | 440/220 | G. E. | ATI | 600 |
| 125 | 440/220 | Whse. | HR | 400 |

## SQUIRREL CAGE MOTORS

| H.P. | Volts | Make | Type | Speed |
|---|---|---|---|---|
| 600 | 2200 | G. E. | FT | 3600 |
| 500 | 2300/4000 | Elliot | SC | 1800 |
| 500 | 2200 | G. E. | | 450 |
| 400 | 2300/400 | Whse. | CS | 720 |
| 300 | 2200 | L. Allis | FS | 1800 |
| 225 (2) | 2300/440 | G. E. | KT | 1200 |
| 200 | 440 | G. E. | IK | 720 |
| 200 | 440/220 | G. E. | KT | 1800 |
| 200 | 2200/440 | G. E. | JK | 600 |
| 200 | 2200 | G. E. | KT | 1800 |
| 150 | 440/220 | Whse. | CS | 900 |
| 150 | 2200 | Al. Chal. | AR | 1800 |
| 150 | 220 | Whse. | CS | 1200 |
| 150 | 440/220 | G. E. | IK | 450 |
| 150 | 440/220 | G. E. | KT | 720 |
| 150 | 2200/440 | | KT | 600 |

## A. C. GENERATORS

1—320 kva, 668 rpm 2300/440/230 V., G.E.
1—300 kva, 900 rpm, 460/220 V., G.E.
1—225 kva, 600 rpm, 220/440 V., G.E.
1—200 kva, 720 rpm, 2200/440 V., G.E. (Ball)
1—187 kva, 1200 rpm, 2300/440 V., Whse.

## CIRCUIT BREAKERS

2—2000 amp. GO E., 3 pole, 600 V.
2—1600 amp. ITE, 3 pole, 600 V.
6—FKR-150-28, 600 amp., 15,000 V., G.E.
1—FKR-143, 1200 amp., 4500 V., G.E., Sol. op (new)

## D. C. MOTORS

| H.P. | Volts | Make | Type | Speed |
|---|---|---|---|---|
| 225 | 230 | Whse. | BK | 2870 |
| 150 | 230 | Whse. | BK | 1750 |
| 100 | 230 | Whse. | BK | 400/1200 |
| 90 | 230 | G. E. | CD | 1750 |

## MOTOR GENERATOR SETS

| KW | Make | Input V., AC | Motor Type | Output V., DC |
|---|---|---|---|---|
| 350 | Whse. | 2200 | Syn. | 250 |
| 175 | G. E. | 220/440 | Syn. | 230 |
| 125 | G. E. | 440/220 | Syn. | 250/125 |
| 100 | Al. Ch. | 220/440 | sq. ca. | 240/120 |
| 100 | Whse. | 440/220 | sq. ca. | 125 |
| 75 | G. E. | 2300/440 | Syn. | 125 |
| 65 | G. E. | 2300/440 | sq. ca. | 250 |

## TRANSFORMERS 60 Cy.

1—600 kva, Standard, 13,800-2300 V., 3 ph.
3—500 kva, Whse., 66000—2300 V.
3—333 kva, G. E., 13800—2300 V.
3—200 kva, G. E., 2300—575 V.
3—200 kva, G. E., 11000—2300 V.
3—200 kva, G. E., 4150—480/240 V.
3—150 kva, Al. Chal., 2400—240/480 V.
6—100 kva, Whse., 2400—120/240 V.

*only partial listing*

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HARRY J. RICE, Pres.

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**1 YEAR GUARANTEE**

**Partial Listing ONLY!**

**1000 KVA PYRANOL BANK**

3—333 KVA GE type H form K2DA, 1 ph 60 cycle transformers 13800 volts primary, 460 volts secondary, ser. #6417472—3 & 4.

**SYNCHRONOUS CONDENSER**

1250 KVA Westg., 480 volts, 1200 RPM, with 15 KW direct connected Excitor. Late modern. Complete.

**125 VOLT DC GENERATORS**

| KW | Make | Speed |
|---|---|---|
| 200 | West. | 900 |
| 150 | Westg. | 1200 |
| 100 | Cr. Wh. | 1200 |
| 100 | E.M. | 1200 |
| 100 | G. E. (2) | 900 |
| 100 | Westg. | 1200 |
| 100 | Westg. (2) | 900 |
| 75 | G. E. (2) | 1200 |
| 50 | Westg. (2) | 1150 |

**250 VOLT DC GENERATORS**

| KW | Make | Speed |
|---|---|---|
| 750 | G. E. | NEW |
| 300 | West. (2) | 900 |
| 250 | Cr. Wh. | 1200 |
| 200 | El. Mchy. | 900 |
| 150 | G. E. | 1200 |
| 125 | G. E. (2) | 1200 |
| 125 | E. D. | 1750 |
| 100 | Delco (4) | 1150 |
| 75 | Westg. | 900 |
| 75 | Cr. Wh. | 1150 |

***Motor Generator Set Headquarters***

***Any Voltage or Frequency***

**Please Send Us Your Inquiries**

WRITE WIRE or PHONE LAfayette 6-6976

**L.J. LAND INC.**

**148 GRAND STREET**

**NEW YORK 13, N. Y.**

**COMPLETE POWER PLANT**

4—1285 HP B. & W. Boilers, rated #225 psig steam, A.M.S.E. code, lower tubes ratubed in 1952, C/W underfed stokers, boiler feed pumps, blowers, Cochrane Heater, pipes, valves, etc.

1—15,000 KVA G.E. Turbo-Gen. Set, type ATB-4, 3 ph., 60 cy., 9000 v., 1800 R.P.M., d/c to a Curtis Condensing Turbine, #200 psig steam, 20,000 sq. ft. Surface Condenser and all other equipment.

1—Skip Hoist Unit, 60 cu. ft. electric driven with 70 ft. Elev. Tower and Cone Shaped Steel Storage Bunker, Catenary Suspension for truck or car loading. Complete.

1—15 ton Link-Belt Std. gauge, 8 wheel, Steam Locomotive Crane, new 1931.

*Location—Albany, New York. Price upon request.*

**PHILA. TRANSFORMER CO.**

**2829 Cedar St. Phila. 34, Pa.**

**400 KW NON-CONDENSING TURBINE GENERATOR**

500 KVA—400 KW, 80% PF Allis Chalmers generator, 3 phase 60 cycle, 480 volt, 1200 RPM connected through reduction gear to a:

400 KW Terry non-condensing turbine, 325-400#, 100-125# gauge back pressure, 3800 RPM. Direct connected exciter, switchboard, instruments, spare parts. RECONDITIONED.

**UTILITIES MACHINERY CORP.**

**1965 E. SIXTH ST., CLEVELAND 14, OHIO**

**FOR SALE**

**(5) OIL FIRED B&W BOILERS**

75,000 lbs. per hour—11,147 sq. ft. heating surface — 200 lbs. working pressure. Cross drum—sectional header—30 sections wide. IN EXCELLENT CONDITION. LOCATED BALTIMORE, MD.

**(2) EX-LIBERTY SHIP BOILERS**

24,000 pounds per hour—4890 sq. ft.—225 pounds working pressure. Made by Combustion Engineering Co.

**(3) SCOTCH MARINE BOILERS**

225 pounds working pressure. Approximately 17,500 pounds each, per hour. 1943.

**(4) 300 KW G.M. 8-268A DIESEL GEN.**

G.M. diesel generator sets—120/240 volts DC—1200 RPM—1250 amps.—8 cyl. 6½x7—with switchgear.

**(6) 300 KW TURBO GENERATOR SETS**

120/240 volts DC—Joshua-Hendy turbine—250 lb. W.P. condensing. Suitable for pressures to 440 lbs. at 740°TT. Geared to 1200 RPM. 300 KW Westinghouse 120/240 volt 1250 amp. stabilized shunt generator. With switchgear. Built 1945. Excellent condition.

**COCHRANE DEAERATOR**

220,000 lbs./hr.—1800 gal. storage volume—max. pressure 20 lbs.

**MOTORS AND GENERATORS—all sizes**

**THE BOSTON METALS CO.**

**313 E. Baltimore Street**

**Baltimore 2, Md.**

**Curtis 7-5050**

**MOTORS MG SETS**

| Qty. | HP | Make | Voltage | Speed |
|---|---|---|---|---|
| 13 | 2000 | West. | 525/600 | 600 RPM |
| 28 | 1500 | West. | 525/600 | 600 RPM |
| 31 | 1500 | Al. Ch. | 525/600 | 675 RPM |
| 4 | 1200 | Al. Ch. | 525/600 | 600 RPM |
| 3 | 900 | Elliott | 230 | 500/195 RPM |
| 9 | 800 | West. | 525/600/600/900 | RPM |
| 1 | 650 | Cr. Wh. | 230 | 675/750 RPM |
| 1 | 500 | West. | 230 | 250/500 RPM |
| 1 | 400 | G.E. | 230 | 180/360 RPM |
| 7 | 400 | Elliott(new) | 230 | 400/800 RPM |
| 5 | 400 | West. (new) | 230 | 375/750 RPM |
| 2 | 350 | Cr. Wh. | 230 | 400/800 RPM |
| 1 | 350 | Cr. Wh. | 230 | 500/750 RPM |
| 1 | 200 | Cr. Wh. | 230 | 375/750 RPM |

All motors designed for mill reversing service.

Smaller sizes also in stock.

**Motor Generator Sets in Stock**

**100—2000 K W Capacity**

All of above is modern late type equipment remanufactured & tested by our engineers.

**Write, Wire, Phone**

***All guaranteed for one year***

**A. G. SCHOONMAKER CO., INC.**

**50 CHURCH STREET, NEW YORK 7, N. Y.**

**Plants: SAUSALITO (S.F.) CAL., JERSEY CITY, N.J.**

**HIGH PRESSURE FEED WATER HEATERS**

206 sq ft surface, 6 pass, steel shell 210 brass tubes ⅝" OD .065" thick tube W.P. 975# psi, shell W.P. 10# psi mfd. by Struthers Wells. Never used.

**HUGO NEU CORPORATION**

31 Nassau Street New York 5, N. Y.

Tel: REctor 2-1334

108 HP 180 lb. "1946" Scotch Marine Boiler
30 HP 200 lb. Erie City Economic Boiler
100 HP "1947" Portable Locomotive Type
100 HP 125 lb. "1942" Kewanee Gas Boiler
20—40—40—250—330 HP Erie City Boilers
25 Ton GE Diesel Electric Locomotive
2 Ton Shaw Elec. Hoist with Track
17 Ton Steam Locomotive

**H. & P., 6719 Etzel Ave., St. Louis 14, Mo.**

## RE-NU-BILT
*GUARANTEED*
## ELECTRIC POWER EQUIPMENT

### D. C. MOTORS

| Qu. | HP | Make | Type | Volts | RPM |
|---|---|---|---|---|---|
| 1 | 2200 | G.E. | MCF | 600 | 400/800 |
| 1 | 2000 | Whse. | Mill | 600 | 230/460 |
| 1 | 1200 | G.E. | MCF | 600 | 750/950 |
| 1 | 940 | Whse. | QH | 250 | 140/170 |
| 1 | 900 | Whse. | | 230 | 450/550 |
| 1 | 825 | Whse. | | 250 | 95/190 |
| 1 | 800 | Al. Ch. | | 250 | 400/800 |
| 1 | 500 | Whse. | CC-218 | 600 | 300/900 |
| 1 | 500 | G.E. | MCF | 600 | 300/900 |
| 2 | 450 | Whse. | | 550 | 415 |
| 1 | 300 | Whse. | CB-511.3 | 250 | 400/900 |

## A. C. MOTORS—3 Ph. 60 Cy.

### SLIP RING

| Qu. | H.P. | Make | Type | Volts | Speed |
|---|---|---|---|---|---|
| 1 | 1500 | G. E. | MT-480 | 2300 | 360 |
| 1 | 1500 | ABB | | 2300 | 720 |
| 1 | 1200 | G. E. | MT | 2300 | 275 |
| 2 | 1000 | A. C. | Mill | 2300 | 240 |
| 1 | 1000 | G. E. | MT-452 | 2300 | 321 |
| 1 | 560 | G. E | M-574Y | 6900 | 900 |
| 1 | 500 | Whse. | CW | 550 | 350 |
| 1 | 400 | Whse. | CW-960A | 440 | 1170 |
| 1 | 400 | Whse. | CW | 440 | 514 |
| 1 | 400 | Whse. | CW-1218 | 2200 | 435 |
| 1 | 350 | G. E. | MT-442 Y | 2200/4000 | 253 |
| 1 | 350 | G. E. | IM-17A | 440/2200 | 720 |
| 1 | 250 | G. E. | MT-424-Y | 4000 | 257 |
| 1 | 230 | G. E. | MT-5396 | 2300 | 1800 |
| 1 | 250 | Al. Ch. | | 550 | 600 |
| 1 | 200 | G. E. | MTP-559 | 440 | 1170 |

### SQUIRREL CAGE

| | | | | | |
|---|---|---|---|---|---|
| 2 | 650 | G. E. | FT-559BY | 440 | 3570 |
| 2 | 450 | Whse | CS-1420 | 2300/4150 | 354 |
| 1 | 300 | Whse. | CS | 440 | 1170 |
| 1 | 200 | G. E. | IK-17 | 440 | 580 |
| 3 | 200 | G. E. | KT-537 | 440 | 1800 |
| 1 | 150 | Whse. | CS-8568 | 440 | 880 |
| 1 | 150 | Whse. | CS | 440 | 580 |
| 1 | 150/75 | G. E. | IK | 440 | 900/450 |
| 3 | 125 | Al. Ch. | ARW | 2200 | 1750 |

### SYNCHRONOUS

| | | | | | |
|---|---|---|---|---|---|
| 1 | 4350 | C. W. | 25s1-8L | 13800/6900 | 514 |
| 2 | 2100 | G. E. | ATI | 2300 | 360 |
| 2 | 1750 | G. E. | ATI | 2300 | 3600 |
| 2 | 2000 | Whse. | | 2300 | 120 |
| 3 | 735 | G. E. | ATI | 2200/12000 | 600 |
| 1 | 720 | G. E. | Ts | 2300/4600 | 720 |
| 1 | 500 | Ideal | SM | 2300/4160 | 1800 |
| 1 | 500 | Whse. | | 440 | 900 |
| 1 | 450 | Whse. | | 2200 | 1285 |
| 1 | 450 | Whse. | | 2300 | 450 |
| 1 | 400 | G. E. | Ts | 2200 | 400 |

### M-G SETS—3 PH. 60 CY.

| Qu. | K.W. | Make | RPM | DC Volts | AC Volts |
|---|---|---|---|---|---|
| 2 | 2000/2400 | G. E. | 450 | 250/300 | 2300/4600 |
| 2 | 2000 | G. E. | 450 | 600 | 2300/4000 |
| 1 | 2000 | G. E. | 600 25cg | 650 | 11000 |
| 2 | 2000 | G. E. | 514 | 600 | 6600/13200 |
| 1 | 1500 | G. E. | 720 | 600 | 6600/13200 |
| 1 | 1500 | C. W. | 514 | 30/115 | 4000/12000 |
| 3 | 1000 | G. E. | 720 | 600 | 2300/4600 |
| 1 | 1000 | G. E. | 900 | 260 | 4000 |
| 1 | 750 | C. W. | 514 | 30/115 | 2300 |
| 1 | 600 | G. E. | 720 | 250 | 440/2300 |
| 1 | 500 | Whse. | 1200 | 115/230 | 2300 |

### TRANSFORMERS

| Qu. | KVA | Make | Type | Ph. | Voltages |
|---|---|---|---|---|---|
| 1 | 5000 | Whse. | OISC | 3 | 2300x2640 |
| 1 | 2500 | Whse. | OISC | 3 | 26400/13200x46 |
| 3 | 2000 | G. E. | HVDDJ | 1 | 66000/13800 |
| 3 | 667 | G. E. | HD | 1 | 13800x2300 |
| 3 | 1000 | G. E. | HVDDJ | 1 | 2400x480 |
| 6 | 1000 | Wagner | OISC | 1 | 13200x46 |

### FREQUENCY CHANGER SETS

| Qu. | KW | Make | Freq. | Voltages |
|---|---|---|---|---|
| 1 | 12500 | Whse. | 60/25 | 13200/13200 |
| 1 | 3000 | G. E. | 40/25 | 2300/2300/4000 |
| 2 | 2500 | G. E. | 25/62.5 | 2300/2300 |
| 1 | 1000 | G. E. | 25/58.3 | 4400/2300 |
| 1 | 500 | Al. Ch. | 2560 | 11000/2200 |

## TURBO GENERATORS

| Qu. | KW | Make | Desc. |
|---|---|---|---|
| 1 | 4000 | G. E. | Condensing 425—750 P. T. T. Surface Condenser 3/60/2300/4000 V Direct conn exciter |
| 1 | 1500 | Whse. | Auto-extraction 190 lbs.—600° F.T.T. 60 lb. extraction 3/60/240 V. Dir. conn. Exc. |
| 1 | 1000 | Moore | Auto-Ext. Cond. 175/200# I.S.P. 5/20# G. Ext. Surface Condenser—3/60/2300. |
| 1 | 1000 | G. E. | Non-condensing 175/200 lbs. I.S.P. 5/20 lbs. G.B.P., 480/3/60. |
| 1 | 750 | G. E. | Condensing 265# I.S.P. 440V. 3 ph. 60 cy.—New—1944. |
| 1 | 750 | Whse. | —Non-condensing 155# I.S.P. 40# B.P. 750 Kw. 250 V. D.C. |

## BELYEA COMPANY, INC.
43 Howell St., Jersey City 6, N. J.

# "Certified Rebuilt" Motors and Generators

### A. C. GENERATORS — 60 CYCLE

| KVA | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 1000 | Whse. syn cond | | 4000/2300 | 900 |
| 625 | Gen. Elec. | ATB | 2300 | 450 |
| 600 | Gen. Elec. | ATB | 480 | 900 |
| 485 | Allis Ch. | 1 brg. | 440 | 400 |
| 440 | Gen. Elec. | TRB | 240/480 | 450 |
| 312 | Gen. Elec. | ATB | 240/480 | 600 |
| 275 | G. E. 25 cycle | ATI | 480 | 750 |
| 225 | El. Machy. | | 480 | 720 |
| 225 | Gen. Elec. | ATI | 240/480 | 900 |
| 156 | Gen. Elec. | | 240/480 | 1200 |
| 150 | Gen. Elec. | ATB | 2300 | 900 |
| 150 | Whse. | | 2300/480 | 600 |
| 125 | Gen. Elec. (2) | ATB | 240/480 | 900 |
| 75 | El. Machy. | | 2300 | 900 |
| 56 | G. E. | ATB | 240/480 | 1200 |
| 25 | Whse. (3) | 3 phase | 240 | 1200 |
| 25 | Whse. b.b. | 1 phase | 120/240 | 900 |
| 10 | Kato b.b. New | 3 phase | 127/220 | 1800 |

**TWO 300 HP MOTORS—LIKE NEW**
**300 HP Gen. Elec. type M-568 slipring, 3/60/2200/440 V. 720 RPM, w/control.**

### D. C. GENERATORS

| KW | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 500 | Al. Ch. | MECW | 125/250 | 1200 |
| 300 | Allis Ch. b.b. | EW | 350 | 1300 |
| 250 | Gen. Elec. | MPC | 250 | 600 |
| 175 | Allis Ch. b.b. | EW | 250 | 900 |
| 150 | Gen. Elec. b.b. | CDM | 250 | 1150 |
| 105 | Century b.b. | 1500 amp. | 70 | 1200 |
| 100 | GE. | CD | 250 | 1500 |
| 100 | Allis Ch. | E | 125 | 1200 |
| 100 | Allis Ch. | E182 | 250 | 900 |
| 100 | Delco b.b. | Mar. | 125/250 | 1200 |
| 75 | Cont. b.b. | D100X | 125 | 1150 |
| 75 | F.M. b.b. | DH | 125 | 1800 |
| 75 | G.E. b.b. (2) | CDM133 | 125 | 750 |
| 75 | Whse. | 8K | 250 | 900 |
| 60 | Allis Ch. | E147 | 250 | 900 |
| 60 | Whse. b.b. (2) | 8K121 | 300 | 1200 |
| 50 | Cr. Wh. b.b. | CCD | 250 | 1800 |
| 50 | Reliance | T | 250 | 1150 |
| 40 | Whse. | 8K140 | 250 | 1100 |
| 40 | Gen. Elec. | RC32 | 600 | 1750 |
| 25 | Whse. | 8K93 | 125 | 1750 |
| 25 | C.W. b.b. (2) | CCD | 250 | 1200 |

### A. C. MOTORS — 60 CYCLE

| HP | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 750 | G.E. | Synch. | 2200 | 514 |
| 700 | Allis Ch. | Sq. Cage | 440 | 900 |
| 500 | G.E. - | Sq. Cage | 4000 | 1800 |
| 500 | G.E. | Slipring | 2200/440 | 450 |
| 500 | G.E. | Synch. | 440 | 900 |
| 450 | Allis Ch. | Synch. | 480 | 400 |
| 400 | Whse. | Sq. Cage | 2200 | 514 |
| 400 | G.E. | Synch. | 440 | 450 |
| 350 | Whse. (2) | Slipring | 2300 | 450 |
| 300 | G.E. (2) | Slipring | 2200/440 | 720 |
| 300 | El. Machy | Synch. | 220/440 | 360 |
| 300 | Al. Ch. | Sq. Cage | 2200/440 | 720 |
| 300 | Whse. | Synch. | 2200/440 | 600 |
| 300 | G.E. | Slipring | 440 | 360 |
| 250 | F. Morse b.b. | Slipring | 440 | 600 |
| 250 | G.E. | Synch. | 220/440 | 720 |
| 250 | Whse. (2) | Sq. Cage | 2300/440 | 1200 |
| 250 | L.A. (2) | Sq. Cage | 2200 | 1800 |
| 225 | G.E. | Synch. | 220/440 | 900 |
| 200 | Gen. Elec. | Sq. Cage | 220/440 | 1200 |
| 200 | F. Morse b.b. | Slipring | 220/440 | 600 |
| 200 | Reliance b.b. | Sq. Cage | 220/440 | 1800 |
| 200 | Allis Ch. | Slipring | 440 | 450 |
| 200 | Gen. Elec. | Sq. Cage | 2200/440 | 720 |
| 200 | Cr. Wh. | Sq. Cage | 220/440 | 3600 |
| 200 | Whse. | Sq. Cage | 2200/440 | 900 |
| 200 | E. M. | Synch. | 220/440 | 1200 |
| 200 | G.E. | Slipring | 220/440 | 360 |
| 200 | E. M. | Synch. | 220/440 | 514 |
| 175 | G.E. (2) | Synch. | 220/440 | 720 |
| 175 | Whse. | Synch. | 220/440 | 360 |
| 150 | Whse. | Sq. Cage | 220/440 | 900 |
| 150 | G.E. | Synch. | 220/440 | 450 |
| 150 | Allis Ch. | Slipring | 2200/440 | 720 |
| 150 | G.E. (2) | Sq. Cage | 2200/440 | 720 |
| 150 | Allis Ch. | Sq. Cage | 2200/440 | 1200 |
| 150 | Rel. b.b. | Sq. Cage | 220/440 | 1800 |
| 150 | Allis Ch. | Sq. Cage | 440 | 450 |
| 150 | G.E. vertical | Slipring | 4000/2300 | 1200 |
| 125 | G.E. TEFC | Sq. Cage | 220/440 | 3600 |
| 125 | Whse. | Sq. Cage | 220/440 | 900 |
| 125 | Rel. TEFC | Sq. Cage | 220/440 | 1800 |
| 125 | G.E. | Slipring | 220/440 | 450 |
| 125 | E. M. | Synch. | 220/440 | 1800 |
| 125 | Allis Ch. | Slipring | 220/440 | 900 |
| 100 | G.E. | Slipring | 220/440 | 514 |
| 100 | Burke b.b. | Synch. | 220/440 | 1800 |
| 100 | G.E. | Slipring | 220/440 | 900 |

# *Our 49th Year—Check with Wagner First!*

### D. C. MOTORS

| HP | Mfr. | Type | Volts | Speed |
|---|---|---|---|---|
| 300 | Allis Ch. b.b. | EW | 250 | 1000 |
| 300 | Gen. Elec. | MPC | 250 | 600 |
| 700 | Allis Ch. b.b. | EW | 250 | 650 |
| 175 | Whse. | 8K | 230 | 900 |
| 150 | Whse. | 8K-201 | 230 | 300/900 |
| 100 | G.E. | CD123 | 230 | 1150 |
| 100 | Allis Ch. | E182 | 250 | 600/1200 |
| 75 | F. Morse b.b. | DH-140 | 115 | 1600 |
| 75 | Whse. | 8K170 | 230 | 635 |
| 50 | Reliance | 310T | 230 | 850 |
| 50 | Reliance b.b. | 651T | 230 | 750 |
| 50 | Cr. Wh. b.b. | FH | 230 | 1750 |
| 50 | Whse. | 8K185 | 230 | 300/900 |
| 40 | Whse. | 8K140 | 230 | 775 |
| 40 | Whse. | 8K143 | 230 | 600/1500 |
| 40 | Reliance | 651T | 230 | 850/1000 |
| 40 | Gen. Elec. | RC32 | 550 | 1250 |
| 30 | Imperial b.b. | DH3 | 230 | 400/1600 |
| 30 | Star b.b. (3) | 8B | 230 | 1750 |
| 25 | Star b.b. | 8B | 230 | 1750 |
| 25 | L. A. TEFC | RNA | 230 | 850 |
| 25 | Whse. | 8K150 | 230 | 300/1200 |
| 25 | Whse. | 8K160L | 230 | 1150 |
| 20 | Century b.b. | DN326 | 230 | 3500 |
| 20 | G.E. series | CD-1826 | 230 | 875 |

### MOTOR-GENERATOR SETS

| KW | Mfr. | Input V | Output V |
|---|---|---|---|
| 500 | Whse.* | 2300 AC | 250 DC |
| 300 | Allis Ch. | 2200/440 AC | 125/250 DC |
| 250 | Allis Ch. | 2200/440 AC | 250 DC |
| 200 | Cr. Wheeler* | 2300/4150 AC | 250 DC |
| 200 | Whse.* | 220/440 AC | 55 DC |
| 200 | G.E.* | 220/440 AC | 250 DC |
| 200 | Gen. Elec.* | 220/440 AC | 125 DC |
| 150 | Whse. | 2300/440 AC | 275 DC |
| 105 | Century b.b. | 220/440 AC | 70 DC |
| 100 | G.E.* | 2200/440 AC | 125 DC |
| 100 | Allis Ch. | 220/440 AC | 250 DC |
| 100 | Delco b.b. | 220/440 AC | 125/250 DC |
| 80 | Star* b.b. | 220/440 AC | 240 DC |
| 75 | Cont. b.b. | 220/440 AC | 125 DC |
| 60 | Gen. Elec.* | 220/440 AC | 60 DC |
| 60 | Whse (2) | 220/440 AC | 300 DC |
| 50 | Gen. Elec. | 220/440 AC | 125 DC |
| 50 | Cr. Wh. b.b. | 220/440 AC | 240 DC |
| 40 | Gen. Elec. | 220/440 AC | 600 DC |
| 30 | Gen. Elec. (2) | 220/440 AC | 125 DC |
| 30 | F. Morse b.b. | 220/440 AC | 24 DC |
| 25 | Whse. | 220/440 AC | 125 DC |
| 20 | Gen. Elec. | 220/440 AC | 250 DC |
| 15 | El. Prod. | 220/440 AC | 40 DC |

→ *Send for Stock List P-102* ←

## ARTHUR WAGNER COMPANY

1435 W. RANDOLPH ST.
CHICAGO 7, ILLINOIS
TELEPHONE MONROE 6-7409

# 13 SPECIALS

1500 KVA GE 480 v Turbo. non-con.
937 KVA GE 480 v Turbo. non-con.
625 KVA Al Chal TURBO unit, non-cond. 3/60/480/240 v.
250 KVA (2) Wghse 360/480/240 v—7 cyl. DIESEL units
200 KVA (2) GE. 480/240 v—Buckeye 6 cyl. Diesels

1226 KVA F.M. DIESEL Unit 300 R.P.M. 33D16
800 HP (2) B&W 250# BOILERS
680 HP (4) B&W 260# BOILERS
500 HP (3) B&W 160# low head BOILERS
300 HP (2) Keeler 250# PACKAGE BOILERS
300 (2) B&W 160# low head BOILERS
250 HP (2) B&W 225# low head BOILERS
250 HP (2) Union 160# PACKAGE

## POWER PLANT EQUIPMENT CO.
39 CORTLANDT STREET — NEW YORK, N. Y.

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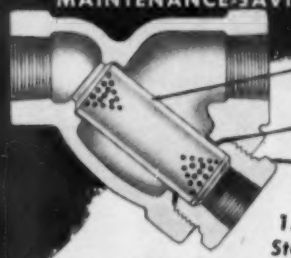


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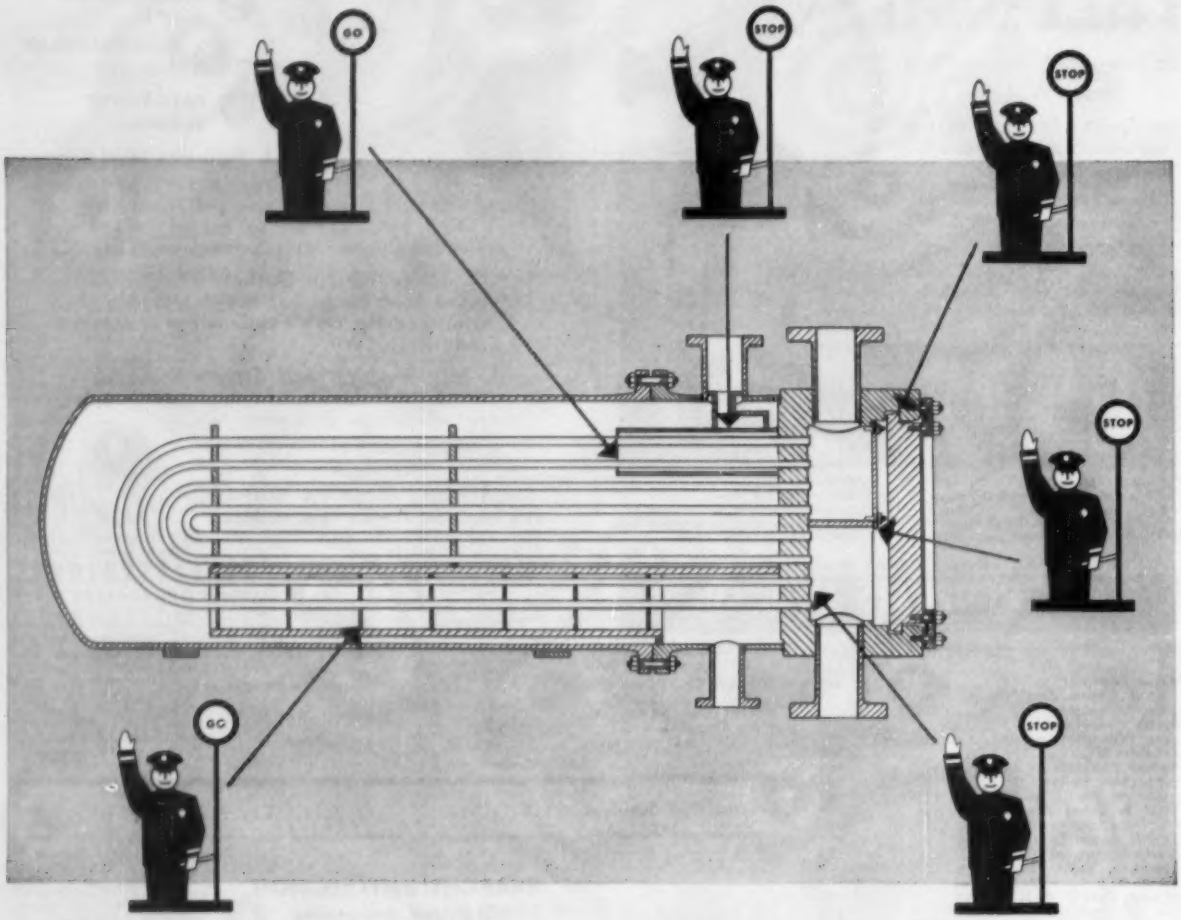
# *The Feedwater Heater with Complete Traffic Control*




Traffic control in a feed water heater? Quite necessary, when you consider how inefficient the heating effect would otherwise be. Imagine the confusion of eddy currents and the consequent severe tube erosion if the steam entered without proper guidance.

In G-R Feedwater Heaters, control of both steam and water is complete and effective—the result of three quarters of a century's experience in the design of heat transfer apparatus by The Griscom-Russell Company.

Where the steam enters these G-R Heaters, its flow is first directed by an impact baffle; and when necessary, by a specially designed desuperheating enclosure before continuing its course through the heater. When sub-cooling is desired, the condensate is further guided through a sub-cooling zone before draining through the shell outlet.

Not only the steam in the shell, but also the water in the tubes is under constant control. Leak-tight tube joints and properly designed gasket joints throughout insure the safe routing of the water through the tubes.

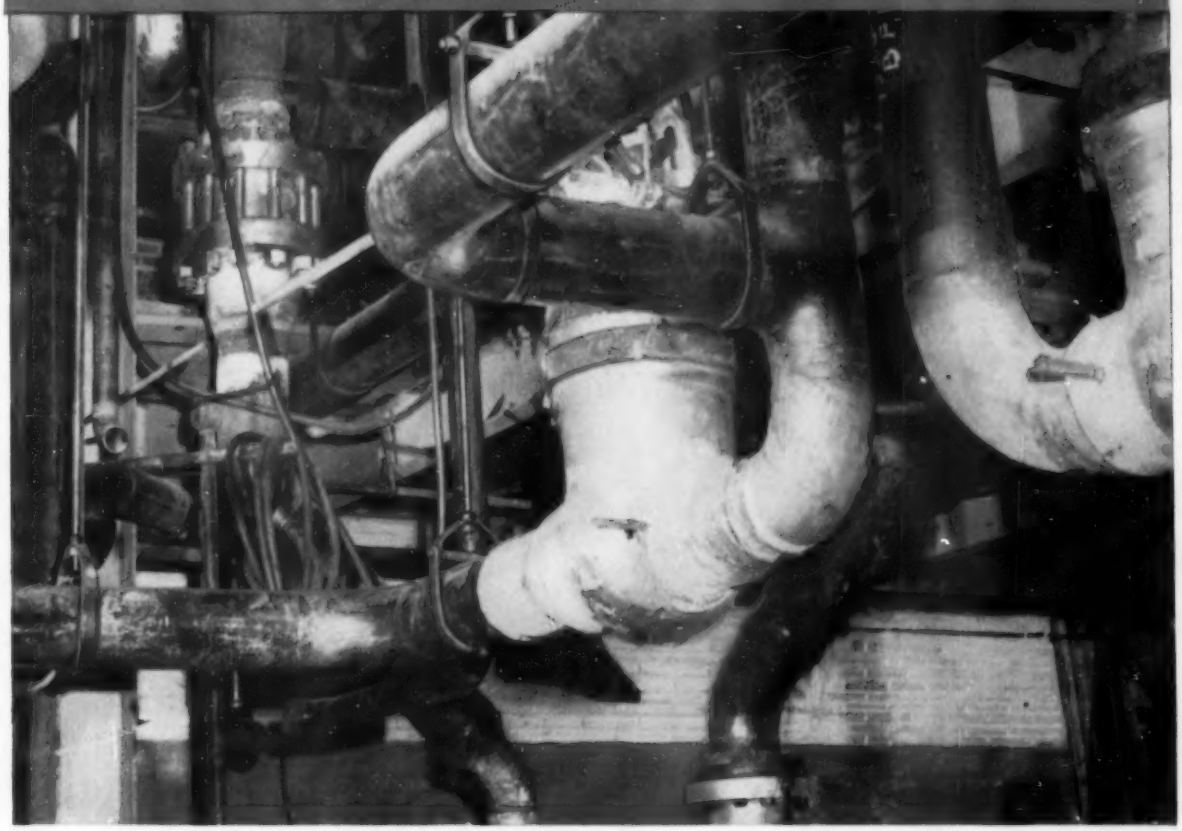
Write for bulletin describing these control measures in detail. It also gives many other reasons why G-R Feedwater Heaters should be your choice, whether for low, medium or high-pressure service.

**THE GRISCOM-RUSSELL CO., MASSILLON, OHIO**

**G-R** HEAT TRANSFER APPARATUS **Feedwater Heaters**

GR 316

# STRONGER THAN PIPE



Boiler feed discharge piping shown under construction above will operate at 2700 psi and 430° F.

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### exceed bursting strength of seamless pipe

Grinnell Welding Fittings are designed and processed to have a bursting strength greater than the calculated bursting strength of the seamless pipe to which they are to be welded.

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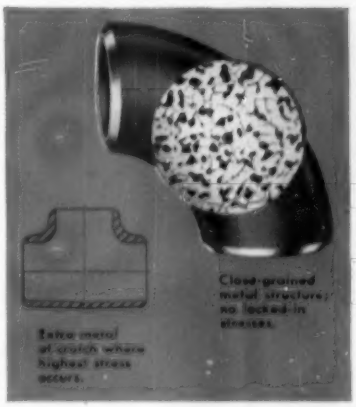
With all Grinnell Welding Fittings, you get true circularity; smooth, clean inside surface; full, effective radius; easy, sweeping turns; accurate bevels; and true included angles. Available in a wide range of types and sizes, metals and alloys. Send for descriptive catalog.

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Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
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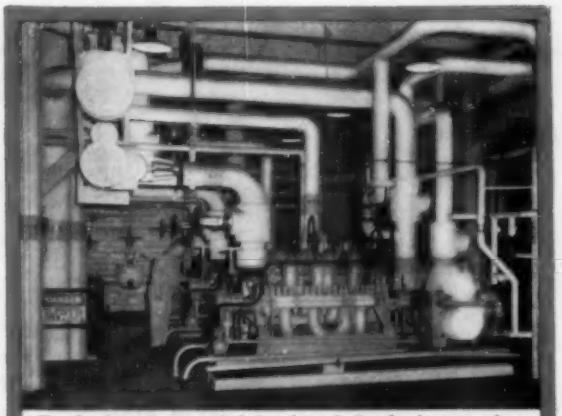
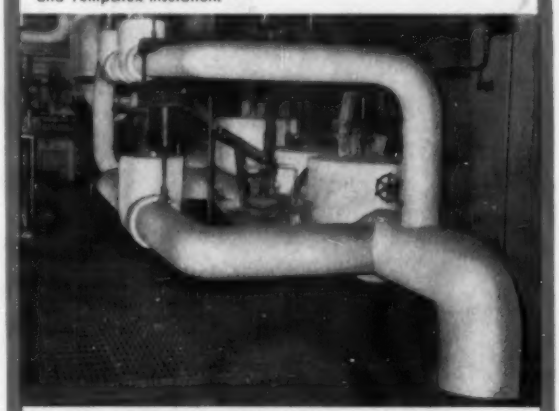
# Carey super-light 85% Magnesia and Tempchek help "wrap up" new 20,000 KW Jamestown Plant

*Efficiency* in every single operation is a must at this plant in order to meet steadily increasing power loads. That's why Carey Super-Light 85% Magnesia and Carey Tempchek were the No. 1 choice for insulating plant boilers and piping throughout the entire new 20,000 KW installation. Fuel economy, maximum thermal efficiency are assured with these time-tested Carey products. They excel in efficiency, strength, workability and light weight . . . stand up under all kinds of humidity, vibration and water conditions . . . save space!

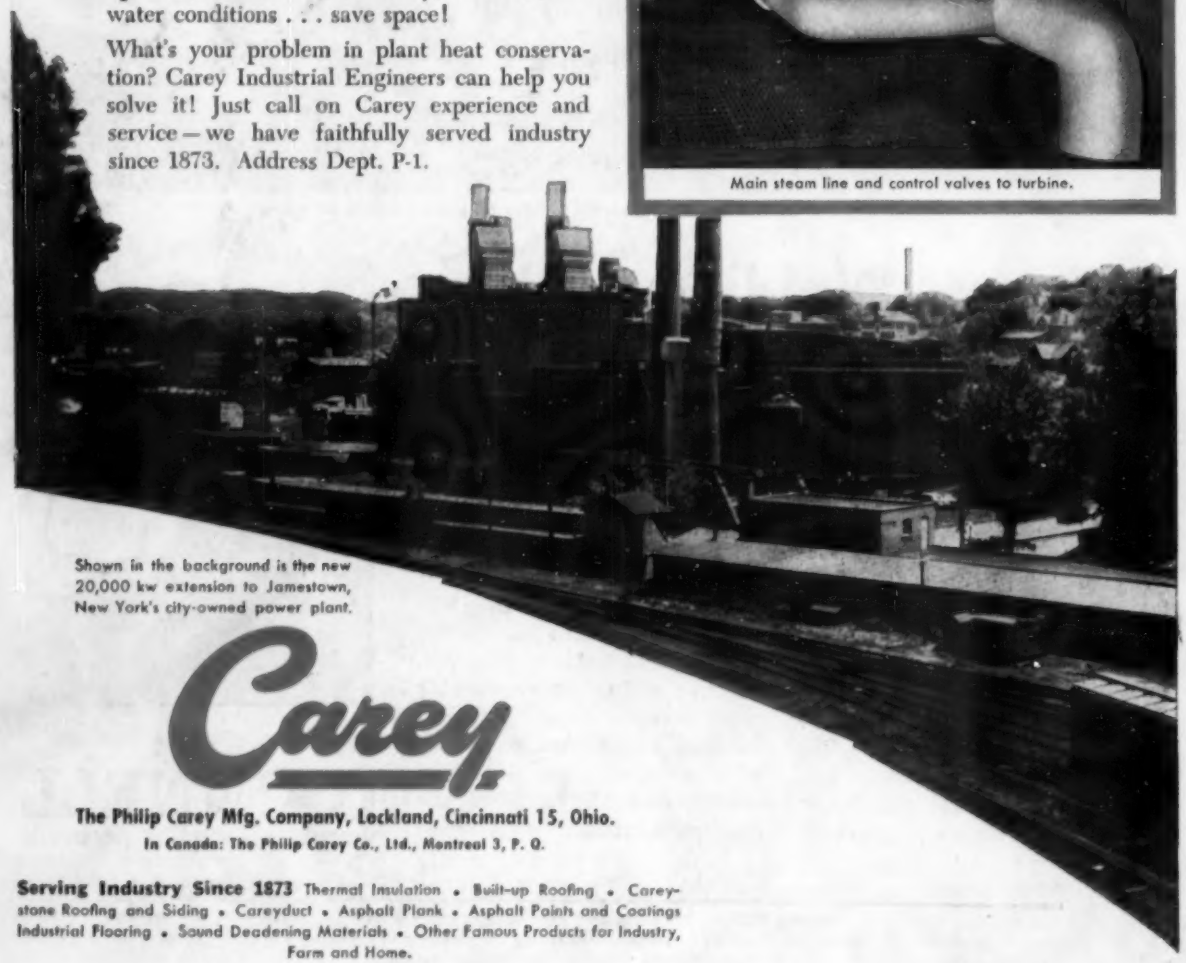
What's your problem in plant heat conservation? Carey Industrial Engineers can help you solve it! Just call on Carey experience and service—we have faithfully served industry since 1873. Address Dept. P-1.



The feedwater system includes three boiler feed pumps, four closed stage heaters, one de-aerating heater, and an evaporator. All piping is covered with Carey 85% Super-Light Magnesia and Tempchek insulation.



Main steam line and control valves to turbine.



Shown in the background is the new 20,000 kw extension to Jamestown, New York's city-owned power plant.

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